TRANSPORT PLANNING AUTHORITY
MINISTRY OF TRANSPORT
THE ARAB REPUBLIC OF EGYPT

No.

MiNTS – MISR NATIONAL TRANSPORT STUDY

THE COMPREHENSIVE STUDY ON THE MASTER PLAN FOR NATIONWIDE TRANSPORT SYSTEM IN THE ARAB REPUBLIC OF EGYPT

FINAL REPORT

TECHNICAL REPORT 13

COUNTERPART TRAINING PROGRAM

March 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
ALMEC CORPORATION
KATAHIRA & ENGINEERS INTERNATIONAL

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CHAPTER 1: INTRODUCTION

1.1. BACKGROUND

The Japan International Cooperation Agency (JICA) and the Transport Planning Authority of the Ministry of Transport are cooperating in the conduct of the *Comprehensive Study on The Master Plan for Nationwide Transport System in the Arab Republic of Egypt* (MiNTS – Misr National Transport Study), based upon agreements finalized during July, 2009[1]. Oriental Consultants Company Limited, headquartered in Tokyo, Japan, is the designated lead consultant for the study. Associated firms are Almec Corporation, Japan and Katahira & Engineers International, Japan. Technical efforts in Egypt were initiated during December, 2009.

1.2. THE MINTS FRAMEWORK

1.2.1. Study Scope and Objectives

MiNTS is comprehensive in nature, that is, approaches have been designed to mitigate transport problems and contribute to the sustainable development of the nation. Investigative efforts extend over the entirety of the Republic (Figure 1.2.1), with a particular focus being major corridors of movement for both persons and cargo. All major modes of transport are addressed including road, rail, maritime, inland waterway, civil aviation and pipeline. However, the practical master planning focus falls upon those modes falling under the jurisdiction of the Ministry of Transport; that is, the road, rail, maritime and inland waterway sectors.

Five key milestones form the foundation upon which planning efforts are based:

- Establish a nationwide, multi-modal database whose validity rests on a series of focused transport survey and data collection exercises;
- Formulate overall strategies and policies for development of the nationwide transport fabric;
- Develop an integrated, multi-modal transport master plan with years 2017, 2022 and 2027 being short, medium and ultimate planning horizons, respectively;
- Identification, within the master plan framework, of high-priority projects; and,
- Implementation of an effective and productive technology transfer program with Egyptian counterparts.

[1] *Scope of Work - Comprehensive Study on The Master Plan for Nationwide Transport System in the Arab Republic of Egypt*, as mutually agreed upon between the Japan International Cooperation Agency and the Ministry of Transport, Government of Egypt, July 16, 2009.

Source: JICA Study Team

Figure 1.2.1 MiNTS Study Area

The transport strategy embedded within MiNTS must concurrently contribute to an efficient economic structure, strengthen linkages within Egypt as well as with neighboring countries, and provide a base for market-oriented transport activity. Economic expansion and social transformations within Egypt are well underway; continuing improvements in productivity and well-being are expected. As economic growth continues, changes in transport activities and behavior will follow suit. Thus, the foci of transport planning must gradually shift from alleviation of present deficiencies to realization of a transport system founded upon sustainable evolution and integrated, mutually supportive transport solutions. This strategy is particularly valid given the almost 20-year planning horizon adopted by MiNTS.

1.2.2. A Consultative Planning Process

The final structure of MiNTS, and the successful reception thereof, can only be achieved as a direct result of cooperative efforts and close liaison between the Study Team and local experts. Considerable efforts have been expended in gathering information, reviewing previous studies and holding numerous discussions to enhance knowledge of, and sensitivity to, local transport conditions, norms and practices.

The Study Team, housed in the offices of the Transport Planning Authority, Ministry of Transport, is being strongly assisted by its designated counterpart Special Working Group, Coordination Committee and Steering Committee. Thus, continuous and productive technical liaison is being maintained with a number of organizations including the Ministry of Transport and various entities thereof (Office of the Minister, Transport Planning Authority, Egypt National Railways, General Authority for Roads, Bridges and Land

Transport, General Authority for River Transport, Maritime Transport Sector); the Ministry of Housing, Utilities and Urban Communities; Ministry of Civil Aviation; Ministry of Agriculture and Land Reclamation; Ministry of Trade and Industry; Ministry of Industrial Development; Ministry of Interior; Ministry of Local Development; Ministry of Finance; State Ministry of Foreign Affairs, Sector of International Cooperation; Ministry of the Environment; CAPMAS (Central Agency for Public Mobilization and Statistics); as well as various Governorates and entities thereof. Close coordination has also been effected with Universities and various departments within those learned institutions.

Likewise, effective consultations are programmed with various international agencies, funding institutions, donors, and consultant groups in order to obtain an overview of previous, current, and likely future activities and/or involvement in Egypt.

1.2.3. Sustainability and Human Resources Development

The components of the Master Plan diversify beyond the traditional "hardware" concepts associated with infrastructure provision. Additional key elements of the process consist of "software" aspects, that is, available technology, international standards, and modal integration needs (cargo/passenger terminals, logistics chains, transfer points) as well as "humanware" needs. In the latter case, this represents the cultivation of human resources via the designation of training and education programs as well as other requirements for developing expertise. In other words, "sustainability", or the notion that the planning process must allow Egyptian stakeholders to participate in visualizing and shaping their own future. This is of substantial importance in terms of ownership building if MiNTS is to be adopted and used by the people and their elected officials both during, and following, the conduct of MiNTS.

1.3. REPORTING STRUCTURE

The *Final Report* consists of three elements: *The Master Plan* report, *Technical Reports* and *Appendix Reports*.

- *The Master Plan* report is seen as the main document whose intent is to present, in a synoptic sense, main findings of the MiNTS investigations;

- *Technical Reports* represent a series of sector-specific reports which document the technical underpinning of *The Master Plan* document (Table 1.3.1), and,

- *Appendix Reports* represent task-specific or activity-specific documents and other data summaries, some of which have been developed in response to client group requests.

Table 1.3.1 Technical Reporting Structure

Report Number	Subject
1	Road Sector
2	Rail Sector
3	Inland Waterway Transport Sector
4	Maritime Sector
5	Civil Aviation and Pipeline Sectors
6	Demand Simulation and Scenario Testing
7	Organizational and Functional Aspects of the Transport Sector
8	Private Sector Participation
9	Environmental Considerations
10	The MiNTS Vision, Policies and Strategies
11	Transport Survey Findings
12	Project Prioritization
13	Counterpart Training Program

Source: JICA Study Team

CHAPTER 2: THE TRAINING PROGRAM FRAMEWORK

The MiNTS planning process encompasses hardware (infrastructure), software (state-of-the-art technology) and humanware (human resources) elements. An accepted notion is that this planning process must allow Egyptian stakeholders to participate in visualizing and shaping their own future. Human capacity building remains a vital concern of the client group. This need is correspondingly enshrined in one of the MiNTS planning pillars; to wit, "…..Implementation of an effective and productive technology transfer program with Egyptian counterparts".

The need for enhanced human resources is unquestioned. The Ministry of Transport suffers from a severe shortage of qualified staff. There is a lack of training programs and human resource development, in particular related to the introduction (and maintenance) of modern technologies. Yet sound planning of transport activities depends to a great extent on the accuracy and reliability of a unified and multi modal data system. The Ministry of Transport does not have a centralized data bank. Data "centers" exist sponsored by the sectors; however, these have evolved according to varying quality standards and along differing formats. The absence of GIS or similar computerized record keeping is almost universal. Due to the new trends of intermodal logistics in passenger and cargo transport, having a centralized data bank that collects and updates all data and information has became a necessity. Furthermore, the processing of such data, that is, the initial steps of transport planning, is equally fractured. There is no central authority responsible for a unified approach to transport planning, nor does there exist (until the advent of MiNTS) a single, nationwide transport model.

2.1. THE PRIME INTENT

The primary tenet of the counterpart training program, established in close consultation with the client group (and as documented in the subsequent chapter), is to facilitate the transfer of knowledge for key analytical elements of MiNTS. Core elements thereof are:

- Transport survey data

  Rationale: A massive national data collection exercise was completed encompassing 15 surveys across five major national transport modes; that is, road, rail, maritime, inland waterway and civil aviation. These data are seen as an invaluable resource in terms of transport sector demand, preferences and characteristics. Furthermore, familiarity with approaches, methodologies and techniques inherent to the MiNTS surveys will support the periodic future updating/enhancement of relevant data sets via additional surveys. This will maintain, on an on-going basis, a reliable and consistent source of information for all members of the Egyptian transport community.

  Objective: establish familiarity with the form and structure of the MiNTS survey program.

- The national geodatabase.

  Rationale: The MiNTS GIS database contains data collected via the MiNTS transport surveys plus other supporting resources collected from a variety of Egyptian institutions. This database is seen as one of the most comprehensive in Egypt. Familiarity with the database, and underlying GIS concepts, is a vital prerequisite for further applications thereof.

  Objective: establish familiarity with the GIS software and structure of the geodatabase.

- The MiNTS National Transport Model (MNAM).

  Rationale: The MNAM a computerized transport model using CUBE software for the simulation of national passenger and cargo demand across all adopted modes of transport, for public and private means of conveyance. The CUBE model is intrinsically linked with the MiNTS geodatabase. The MNAM is seen as a key product which should continue to be applied in future to ensure consistent approaches to transport planning among the various transport entities.

  Objective: A thorough working knowledge of MNAM, and its various modules and sub-modals, is seen a key focus of the training program.

- The broader notion of transport planning.

  Rationale: The continued use and application of the MNAM relies not only on mathematical concepts and computerized applications, but also an understanding of transport planning principles.

  Objective: While the training program cannot be expected to replace proper academic and professional credentials, theoretical approaches, as relevant to the application of the MNAM, must be addressed to ensure an acceptable breadth of knowledge.

In response, a multi-stage training program was executed. This includes classroom training (by members of the MiNTS Team as well as external specialists from Citilabs (CUBE software) and ESRI (ArcInfo software), followed by practical, day-to-day “hands on” experience as part of the day-to-day investigative processes.

2.2. BROADER IMPLICATIONS

MiNTS has suggested an innovative, yet practical, approach to achieving integrated transport planning for the Republic (Figure 2.2.1). This is documented in Chapter 7 of the main Master Plan Report. In summary,

- The basis of the approach is the over-riding goal of enhanced hardware, software and humanware.
- National transport planning requires an integrated approach which considers the various modes and their capabilities.
- These functions should be physically housed within a dedicated Egypt Transport Center.

- The core objective is the realization of integrated transport planning across all modes and services, supported by "cutting edge" methodologies and state-of-the-art technology.

- The success of the Egypt Transport Center is expected to hinge on joint working relationships between governmental entities, the private sector and academia.

- While indeed the core focus of the Center are those modes managed by the Ministry of Transport, close coordination and working relationships will be necessary with other providers of transport services.

- Within the same spirit and intent, and given the well-established correlation between development and transport, activities of the Center must include, for example, a close working relationship with any entity responsible for promulgation of future land use and/or development plans.

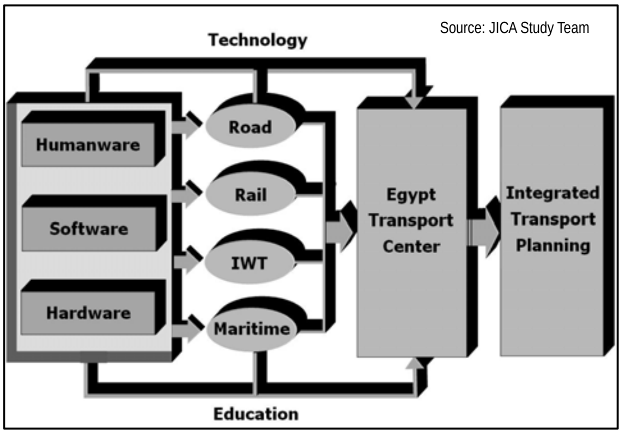

Figure 2.2.1 Framework for The Egypt Transport Center and an Integrated Approach to Transport Planning

Thus, the MiNTS training program is seen as a vital pre-cursor in that the successful graduates of the program can be seen as the "first wave" of cadre to support the creation and operation of the Egypt Transport Center.

CHAPTER 3: TRAINING PROGRAM CONTENT

The MiNTS training program was developed jointly between representatives of the TPA, JICA and Study Team. The program was initiated during May, 2010 and extended though latter 2011, as impacted by available staffing, periods of MiNTS activity and funding availability.

The programs was founded on four cascading steps:

- Stage 1: Knowledge building stage. In-house classroom syllabus administered by MiNTS staff. Objectives were to introduce GIS and CUBE software, terminologies and approaches. Includes hands-on problem solving.
- Stage 2: “Shadow” stage. Working hand-in-hand with MiNTS GIS and modeling specialists to gain practical working knowledge of GIS and CUBE.
- Stage 3: Enhanced application stage. Focused classroom training using external specialists (Citilabs for CUBE, ESRI for GIS). Stage 3 concentrated on more advanced applications of the softwares.
- Stage 4: Continuing participation stage. Builds upon previous stages via on-going joint working efforts in the GIS and modeling sectors.

3.1 STAGE 1: KNOWLEDGE BUILDING STAGE

The initial stage involved four days of classroom training. Stage 1 was successfully carried out during May, 2010. The main intent of the program was to establish familiarity with both theory and practical approaches (Table 3.1.1). Training was conducted in the offices of the TPA (Figure 3.1.1).

Table 3.1.1 Main Topics: Stage 1 Training Program

Session and Time	Day 1	Day 2	Day 3	Day 4
1 (1000-1100 hours)	Introduction and MNAM basics	What is GIS?	The CUBE programs	The Script Language
2 (1115-1215 hours)	Transport planning theory	GIS examples using CUBE	Detailed example: urban model	Practical example
3 (1300-1400 hours)	What is a transport model?	The CUBE flower	Detailed example: freight model	Practical example

Source: JICA Study Team

The Stage 1 program was supported by a series of handouts and lecture materials. These are contained in Appendix 1 to this report. Thirteen persons were nominated for training by TPA (Table 3.1.2).

Table 3.1.2 Stage 1 Training Participants

Name	Organization
Mr. Yasser Mohamed Mahmoud Osman	TPA
Mr. Mohamed Abd El-Sabour El-Sayed	TPA
Ms. Mona Hassan Kotb	TPA
Mr. Ali Ibrahim Mohamed Ali	TPA
Mr. Amgad Abd El-Aleem Mohamed	TPA
Mr. Ayman Mohamed Mohamed Ghazy	TPA
Mr. Ibrahim Said Ibrahim Zoghla	TPA
Mr. Gamal Mostafa Khalil	TPA
Mr. Ahmed El-Sayed Saleh Ata	TPA
Ms. Fatma El-Zahraa Mohamed Morsy	TPA
Mr. Ayman Ahmed Hezk	TPA
Mr. Ahmod M. Maher	TPA
Mr. Mohamed Hessien	TPA

Source: JICA Study Team. Participants nominated by TPA.

Figure 3.1.1 Proceedings of Stage 1 Training

3.2 STAGE 2: "SHADOW" STAGE

The objective of this stage was to give the participants a more detailed background in both GIS and transport modeling techniques. This took place over several weeks between Stage 1 and Stage 3. This stage was to be followed by the enhanced application in October 2010.

4 persons participated in the Stage 2 program (Table 3.2.1).

Table 3.2.1 Stage 2 Training Participants

Name	Organization
Ms. Mona Hasan Kotb	TPA
Mr. Ayman Mohamed Mohamed Ghazy	TPA
Mr. Amgad Abd El-Aleem Mohamed	TPA
Mr. Ibrahim Said Ibrahim Zoghla	TPA

Source: JICA Study Team. Participants nominated by TPA.

3.3 STAGE 3: ENHANCED APPLICATION STAGE

The third stage, completed during September, 2010, was comprised to two inter-locking elements using external specialists:

- CUBE software (training by Citilabs staff). Build upon existing knowledge via structured introduction to the various capabilities of the CUBE software, including specialist components. Syllabus also included hands-on problem solving using the more advanced capabilities of the software. The training program covered:
    - Introduction to Transportation Planning and GIS
    - A description of the Cube programs
    - Using Cube Base (GIS, Scenario Manager, Application Manager, Cube Reports)
    - A description of Cube Voyager
    - A description of Cube Cargo
    - A description of Cube Avenue
    - A description of Cube Analyst
    - Exercises

  A more detailed syllabus is noted in Table 3.3.1. The extent of training was five days. Training was conducted in the offices of the TPA.

  The Stage 3 CUBE program was supported by a series of handouts and lecture materials. These are contained in Appendix 2 to this report.

Table 3.3.1 Main Elements of Stage 3 CUBE Software Training

Day	Objectives	Morning Session (0930-1230)	Afternoon Session (1330-1700)
1	Introduction to Transportation Planning, Cube and GIS. This course is designed for both interested in learning more about Transportation planning, the integration with GIS and how this is accomplished in Cube	General Introduction of all participants Overview of Cube The basic steps in developing a model What's GIS – introduction to GIS Integrate GIS and Transportation Planning: why and how?	Transport Planning Theory The 4 Step Model – Classic and Activity Based Introduction to Demand Forecasting Demand Forecasting in Cube
2	Scenario Analysis, Editing, and Mapping with Cube. This course is designed for both those who apply existing Cube models to ongoing studies and those interested in learning more about Cube Base's graphical user environment and integrated geographic information system (GIS)	Introduction to Cube Base How to prepare input road networks, transit systems, and junction data	How to inspect, analyze, and compare model outputs Best practices for setting up and running model scenarios How to create standard GIS maps to communicate and share results with others
3	4 steps transportation modeling with Cube Voyager . A training course that introduces you to using the Cube Voyager scripting language to automate common data-manipulation and travel-demand modeling tasks. This course is designed for modelers interested in learning about Cube scripting fundamentals and for those new to travel demand modeling and forecasting.	Introduction to Cube Voyager Basic syntax and structure of Cube Voyager script commands Best practices and techniques for editing Cube Voyager scripts	How to build a standard four-step travel demand forecasting model in Cube Voyager, including trip generation, trip distribution, mode choice, and assignment – Part 1
4	A training course that introduces the Cube Voyager scripting language to automate common data-manipulation and travel-demand modeling tasks. This course is designed for modelers interested in learning about Cube scripting fundamentals and for those new to travel demand modeling and forecasting. Freight Modeling with Cube Cargo.	How to build a standard four-step travel demand forecasting model in Cube Voyager, including trip generation, trip distribution, mode choice, and assignment – Part 2	introduction to Cube Cargo General concepts and theory of Freight modeling How to prepare data to run Cube Cargo Cube Cargo Examples
5	Matrix Estimation with Cube Analyst. A one-day course that teaches you how to use Cube Avenue, the Cube Voyager extension that supports dynamic traffic assignment (DTA) and mesoscopic simulation. Useful for both small subregions and large-scale urban networks, Cube Avenue provides highway assignment results that offer greater details, enabling you to analyze temporal variations during peak periods, entire days, or multiple days.	introduction to Cube Analyst General concepts and theory of matrix estimation How to prepare input data for Cube Analyst using Cube Voyager How to use trip matrix information in forecasting models	introduction to Cube Avenue General concepts and theory of DTA How to prepare data for Cube Avenue using Cube Voyager Simulation visualization techniques, including two-dimensional network animations

Source: JICA Study Team using Citilabs information

- GIS software (training by ESRI staff). Build upon existing knowledge via the structured application of Arc GIS software. Syllabus also included hands-on problem solving exercises. Extent 8 days. Training was conducted in the Cairo offices of ESRI. The core elements of the program included both an introduction to the various GIS platforms plus hands-on practical training exercises implemented via two training modules (Table 3.3.2).

Table 3.3.2 Main Elements of Stage 3 GIS Software Training

Module	Topics
ArcGIS Desktop I	• The big picture of GIS: Basic functions of a GIS; Real-world applications. • Exploring GIS maps: Defining features, layers, and data frames; Exploring map scale; Understanding the relationship between features and attributes. • Exploring a GIS database: Exploring attribute tables; identifying features; symbolizing features based on their attributes; Labeling features based on their attributes. • Creating map layouts: Understanding data view and layout view; using the Layout toolbar; Using map templates; Modifying map elements; Printing maps. • Understanding location: Defining coordinate systems and map projections; Reading and finding location coordinates on a map; Measuring area and distance on a map. • Understanding raster and vector data: Representing geography; storing realworld locations; Symbolizing raster's; using raster and vector data together; Understanding geodatabases. • Acquiring geographic data: Data formats; Methods of creating geographic data; Using ArcCatalog to explore geographic data; using metadata. • Querying data: Understanding and performing attribute queries; Understanding and performing spatial queries. • Analyzing spatial relationships: Understanding overlay; Understanding buffer; Accessing tools in ArcToolbox; Performing Union and Intersect; Buffering features. • Solving problems with GIS: Applying the geographic inquiry process; Using GIS tools to solve a geographic problem; Creating a map to show results.
ArcGIS Desktop II	• Investigating geographic data: How geographic data is stored; Vector and raster data; Geodatabase basics and advantages; Shapefiles; Coverages; CAD data; Managing data in ArcCatalog; Displaying data in Arc Map; Arc Map basics; Data and layers. • Managing map layers: Zooming to layers; Bookmarks; Display windows; Scale ranges; Group layers; Selection layers; Layer files; Creating hyperlinks. • Symbolizing categorical data: Symbology; choosing symbology; Types of symbols (marker, line, fill); creating symbols. • Symbolizing quantitative data: Symbology options (graduated colors, graduated symbols, proportional symbols, dot density, charts); Classification methods (Natural Breaks, Equal Interval, Quantile, Manual); excluding data from a • classification; Rendering raster data. • Labeling map features: Label placement for different feature types (points, lines,polygons); Label symbology; Controlling label display using scale range and SQL query; Label classes; Label expressions; Label ranks and weights; What is annotation?; Geodatabase annotation; Map annotation. • Using coordinate systems and map projections: What is a coordinate system?; Geographic coordinate systems; Datum's; Projected coordinate systems; Map projections; Feature classes and coordinate systems; Data frames and coordinate systems; Geographic transformations; Working with an unknown coordinate system; Projecting data; Defining a projection. • Making a map layout: Working in layout view; Tools for arranging map elements; Data frame properties for layouts; Adding legends, scale bars, and other map elements; Exporting maps; Working with map templates. • Managing tables: Table structure; Layer attribute tables; Nonspatial tables; Getting information from tables; Field properties; Table appearance; Creating graphs and reports; Connecting tables using joins and relates; Cardinality. • Editing features and attributes: Reasons to edit data; Working with the Editor toolbar; Edit sketches; Common editing tools; Edit tasks; Snapping to features while editing; Editing attributes; Calculating values for geometry fields; Working with coincident geometry in a map topology; Typical editing workflow.

Source: JICA Study Team using ESRI information. Software applied include ArcView 9.3, ArcEditor 9.3 and ArcInfo 9.3.

The detailed Stage 3 GIS program is contained in Appendix 3 to this report. The Stage 3 GIS program was supported by a series of handouts and lecture materials. These included a series of four manuals on the use of the software. The handouts are not reproduced within this report as they are proprietary in nature.

A total of 13 persons were nominated by the TPA to participate in the Stage 3 program (Table 3.3.3). Not all participated in both the CUBE and GIS training.

Table 3.3.3 Stage 3 Training Participants

Name	Organization	CUBE	GIS
Mr. Yasser Mohamed Mahmoud Osman	TPA	√	√
Mr. Mohamed Abd El-Sabour El-Sayed	TPA	√	
Ms. Mona Hassan Kotb	TPA	√	√
Mr. Ali Ibrahim Mohamed Ali	TPA	√	√
Mr. Amgad Abd El-Aleem Mohamed	TPA	√	√
Mr. Ayman Mohamed Mohamed Ghazy	TPA	√	√
Mr. Ibrahim Said Ibrahim Zoghla	TPA	√	√
Mr. Ibrahim Izzat Fakhry	GARBLT	√	√
Eng. Sally Bahaa El-Din	GARBLT	√	√
Eng. Yosra fetooh Mahmoud	GARBLT	√	√
Eng. Ola Fawzy Kasem	GARBLT	√	
Mr. Ahmed Mohamed Ezzat	AASTMT	√	
Ms. Yasmine Rashed Mohamed	AASTMT	√	

Source: JICA Study Team. Participants nominated by TPA.

3.4 STAGE 4: CONTINUED PARTICIPATION STAGE

The final stage involved two days per week of on the job training together with homework assignments. Stage 4 was successfully carried out during September and October, 2011. The main intent of the program was to establish familiarity with both theory and practical approaches. Training was conducted in the MiNTS project offices at Zamalek. (Figure 3.4.1).

Four persons participated in the Stage 4 program (Table 3.4.1).

Table 3.4.1 Stage 4 Training Participants

Name	Organization
Ms. Mona Hasan Kotb	TPA
Mr. Ayman Mohamed Mohamed Ghazy	TPA
Mr. Amgad Abd El-Aleem Mohamed	TPA
Mr. Yasser Mohamed Othman	TPA

Source: JICA Study Team. Participants nominated by TPA.

The intention of this training was to ensure the familiarity of the trainees with MNAM and included the following topics:

- Review of the MiNTS Transport Model;
- Detailed multi modal network checking;

- Detailed planning data review and understanding of mode split equations;
- Discussion finalization of multi model transport model structure;
- Network finalization;
- Completion of economic evaluation procedure;
- Development of model runs; and
- Model finalization and documentation.

An important part of this stage was the interaction of the trainees with the professional members of MiNTS.

Figure 3.4.1 Participants of Stage 4 Training

APPENDIX

1. STAGE 1 HANDOUTS AND LECTURE MATERIALS
2. STAGE 3 (CUBE) HANDOUTS AND LECTURE MATERIALS
3. STAGE 3 (GIS) TRAINING PROGRAM CONTENT

APPENDIX 1

STAGE 1 HANDOUTS AND LECTURE MATERIALS

MiNTS
Misr National Transport Study

Itinerary

Counterpart Training Program

Stage 1 – Knowledge Building Stage

Day 1 - Session 1

1

MiNTS
Misr National Transport Study

Knowledge Building Program
Transport Planning and GIS

Presenter: Mr Len Johnstone,
Oriental Consultants

My Background:

Transport Planning and Transport Modelling Projects on every continent with the exception of South America.

Extensive experience in the Middle East with previous projects in Kuwait, Qatar and Egypt.

2

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Knowledge Building Program
Transport Planning and GIS

- **During these approximate three days, we will see examples of transport models and GIS from both in Egypt and around the World.**
- **Presentations will concentrate on procedures so that there will be included both urban and regional examples.**
- **PLEASE REMEMBER THIS IS YOUR COURSE, PLEASE ASK QUESTIONS.**
- **WE NEED TO HAVE DISCUSSIONS NOT JUST LISTENING TO THE LECTURER**

3

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Training Program

Daily Program Sessions

- **Session 1~~ 10:00-11:00**
- **Session 2~~ 11:15-12:15**

  Lunch Break
- **Session 3~~ 13:00-14:00**

4

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Knowledge Building Program

Day 1
- 1 – Introduction, Model Basics
- 2 – Transport Planning Theory
- 3 – What is a Transport Model?

Day 2
- 1- What is GIS?
- 2 – GIS Examples using CUBE!!
- 3- The CUBE Flower

Day 3
- 1- Other CUBE Programs
- 2- Detailed Examples~ an Urban Model
- 3- Detailed Examples ~ a Freight Model

Day 4
- 1- The Script Language
- 2- Practical Example
- 3- Practical Example

5

MiNTS
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Definition of Transportation Planning

Transportation planning is therefore the process of:

- Establishing a vision of what a community wants to be
- Understanding the types of decisions that need to be made
- Assessing opportunities and limitations of the future
- Identifying the near- and long-term consequences of alternative choices
- Relating alternative decisions to goals & objectives
- Presenting information to decision-makers (DM) in a useful, understandable form
- Helping DM prioritize and develop an investment program

Source: Kouros Mohammadian, 2004, Lecture at University of Illinois at Chicago

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Role of Transportation Planning

"The application of technological and scientific principles to the planning, functional design, operation and management of facilities for any mode of transportation in order to provide for the safe, rapid (and reliable), comfortable, convenient, economical, and environmentally compatible movement of people and goods." (ITE, 1987)

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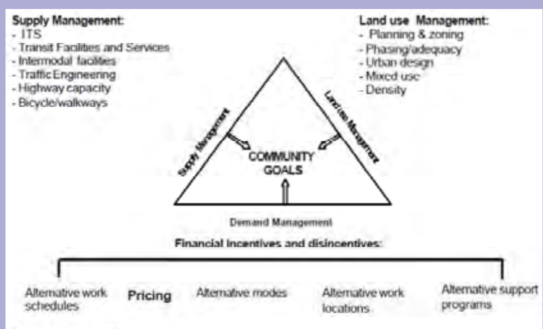
Integrated Transportation Planning

Transportation planning must be seen as an integral part of a much wider process of decision making. Too often in the past transportation solutions have been seen as the only way to resolve transport problems … transport planning must be seen as part of the land-use planning and development processes, which requires an integrated approach to analysis and a clear vision of city and society in which we wish to live. (Banister, 1994)



Source: Meyer (1998)

8

MiNTS
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Transportation Planning Process

- **A decision-oriented approach to transportation planning focuses as much attention on the process of planning as it does on the techniques used**
- **Traditional sequence of planning**
  - Problem definition to a final decision
- **Decision-oriented approach**
  - Understanding the requirements of the final decision
  - Identifying the information and analysis needed to produce them
  - Output of this exercise is directly related to the needs of the decision-making process

9

Source: Kouros Mohammadian, 2004, Lecture at University of Illinois at Chicago

MiNTS
Misr National Transport Study

Current TP Process: Decision-Oriented

- **Decision-oriented approach should;**
  - **Establish the future context**
  - **Respond to different scales of analysis**
  - **Expand the scope of problem definition**
  - **Maintain flexibility in analysis**
  - **Provide feedback and continuity over time**
  - **Relate planning to programming and budgeting**
  - **Provide opportunities for public involvement**

Source: Kouros Mohammadian, 2004, Lecture at University of Illinois at Chicago

10

MiNTS
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Four Steps of Transportation Decision Making

- Problem identification and/or definition
  - Transportation surveys and data collection
  - Data analysis and transportation demand forecast
  - Planning alternatives, evaluation of alt.
- Debate and choice
  - Internal discussion
  - Participatory approach
- Implementation
  - Budgeting, Bidding, Marketing, Management
- Evaluation and feedback
  - Performance indices
  - Evaluation from various points of view including economy, finance, environment, technical, social

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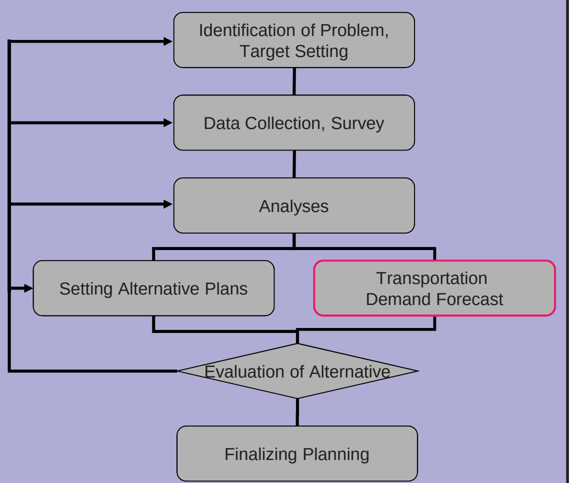
Traditional Transportation – Planning Process

- Collect data to identify problems.
- Analyze the data to find cause of the problems.
- Make a alternative plan to resolve or alleviate the problems.
- Forecast the situation of the case on the implementation of the plan.
- Evaluate the impact of the implementation.



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Transportation Problems ??????...

Aviation and Maritime Transportation

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Transportation problem? ... eg Indonesia

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Transportation Planning Issues

- **Transportation features in Indonesia, could be Egypt as well**
  - Growing car usage
  - Inadequate Public Transport
  - High level of traffic accident (all transport modes)
  - Inadequate transportation infrastructure

- **Constraints in Planning**

- **Budget**
  - Land acquisition (Not so Easy)
  - Political intervention
  - Consideration for poor people

15

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Is it easy?? NO!! However…, YOU can do it!

- **Integration of transportation planning and land use planning in Curitiba, Brazil, The best practice in a developing country.**
  - Integration of land use plan and transportation infrastructure development
  - Bus rapid transit (BRT) enables authorities to build not expensive, high capacity and punctual transportation system
  - New housing development along BRT corridor
  - Pedestrian oriented road use
  - Environmental education
  - Establishment of strong planning institute

- **YOU are the ones who will solve it!! But you need tools----- the transport models**

16

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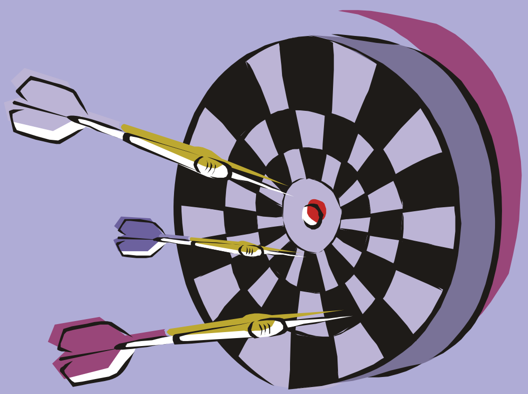
Introduction to Travel Demand Forecasting



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General Discussion of Travel Demand Forecasting Models

- What is a Travel Demand Forecasting Model?
- Why Do Clients Need a Model?
- How Do You Know if the Model is Accurate?
- What is Standard Practice for Model Development and Application?
- How Can a Model be Used?

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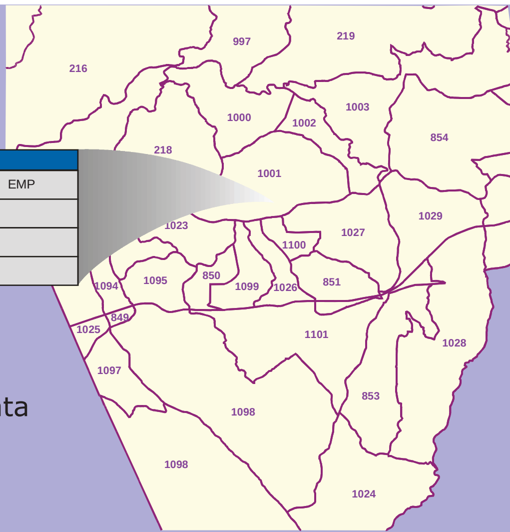
Model Inputs

LANDUSE.DBF			
TAZ	SF	MF	EMP
848			
1025			
1024			



- **Land Use Data**
- Roadway Network Data
- Travel Characteristics Data

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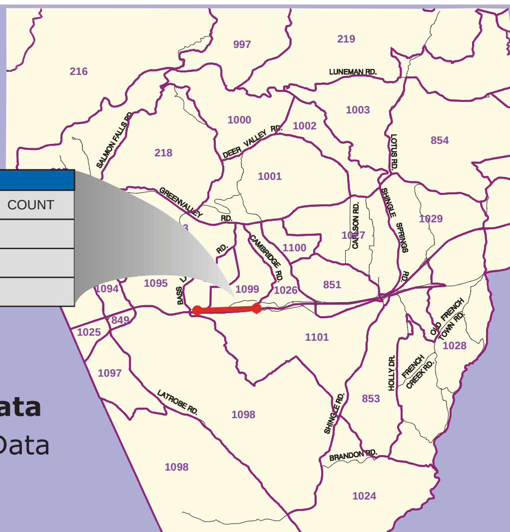
Model Inputs

LINKS.DBF				
LINK	SPEED	DIST	LANES	COUNT
848-1025				
1025-1024				
1024-848				



- Land Use Data
- **Roadway Network Data**
- Travel Characteristics Data

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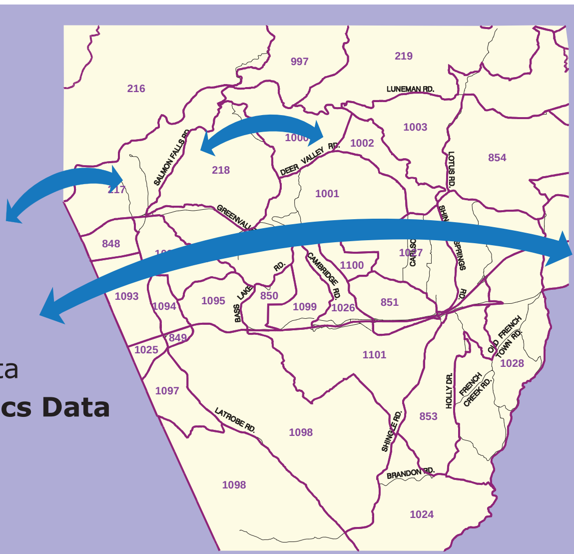
Model Inputs



- Land Use Data
- Roadway Network Data
- **Travel Characteristics Data**

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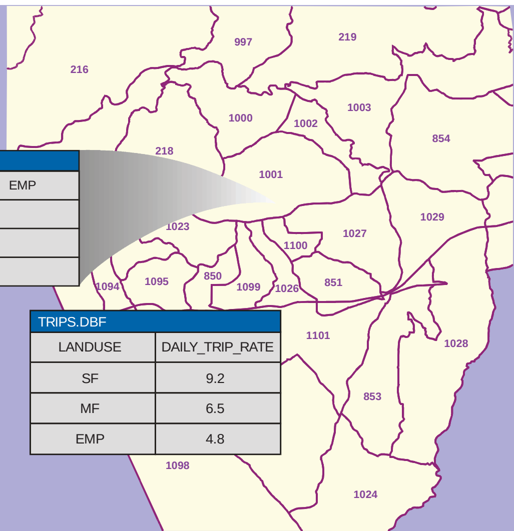
Model Calibration



LANDUSE.DBF			
TAZ	SF	MF	EMP
848			
1025			
1024			

TRIPS.DBF	
LANDUSE	DAILY_TRIP_RATE
SF	9.2
MF	6.5
EMP	4.8

- **Trip Generation**
- Trip Distribution
- Mode Choice
- Trip Assignment

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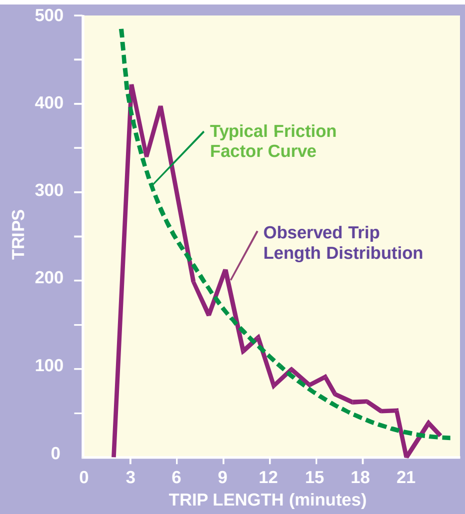
Model Calibration



- Trip Generation
- **Trip Distribution**
- Mode Choice
- Trip Assignment

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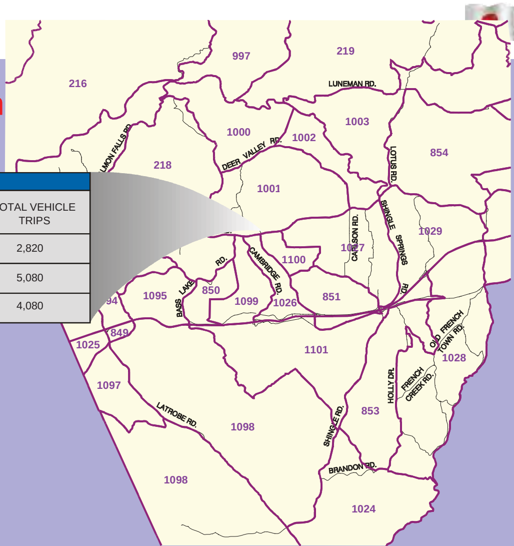
Ca

TAZ	TOTAL PERSON TRIPS	SACMET AUTO-OCCUPANCY FACTOR	TOTAL VEHICLE TRIPS
848	3,100	1.10	2,820
1025	6,100	1.20	5,080
1024	5,100	1.25	4,080



- Trip Generation
- Trip Distribution
- **Mode Choice**
- Trip Assignment

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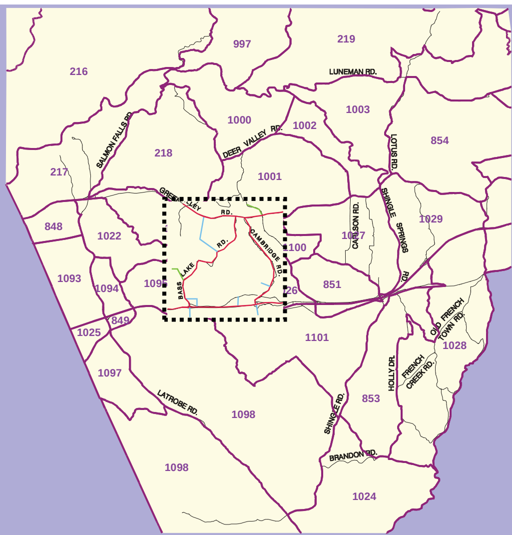
Model Calibration



- Trip Generation
- Trip Distribution
- Mode Choice
- **Trip Assignment**

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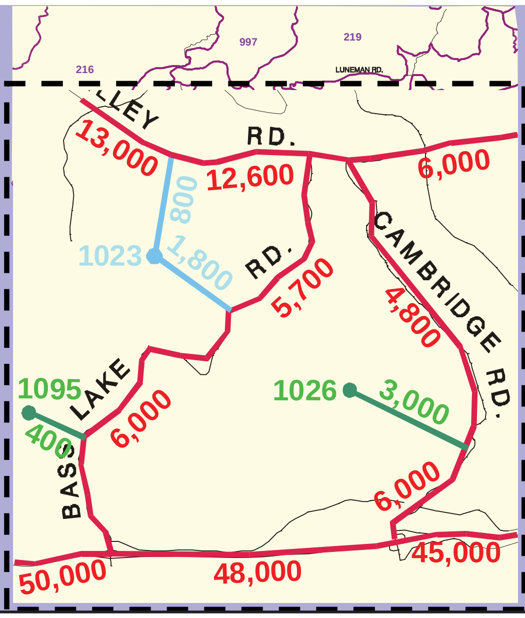
Model Calibration



- Trip Generation
- Trip Distribution
- Mode Choice
- **Trip Assignment**

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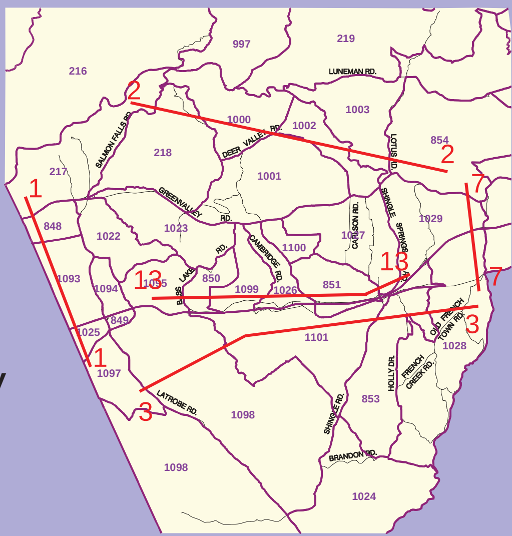
Model Validation



- **Standards**
  - **Screenlines**
  - **Individual Roadway Segments**

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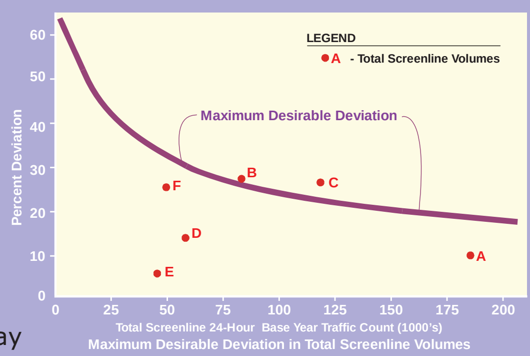
Model Validation



- **Standards**
  - **Screenlines**
  - Individual Roadway Segments

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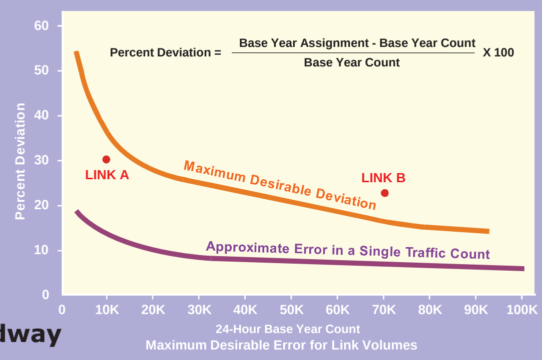
Model Validation



- **Standards**
  - Screenlines
  - **Individual Roadway Segments**

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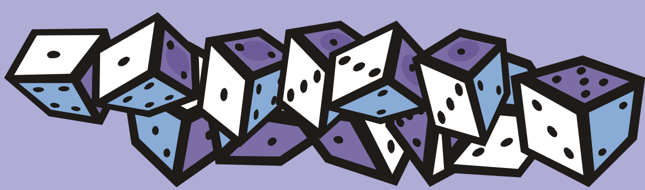
Model Applications

- **Examples**
- **Accuracy**
- **Adjustment Procedures**



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Itinerary

Counterpart Training Program

Stage 1 – Knowledge Building Stage

Day 1 - Session 2

1

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Transport Planning Theory-Overview

- **Person Trip Forecasts**
- **Commercial and External Vehicle Forecasts**
- **Combination of Person and commercial Vehicles**

2

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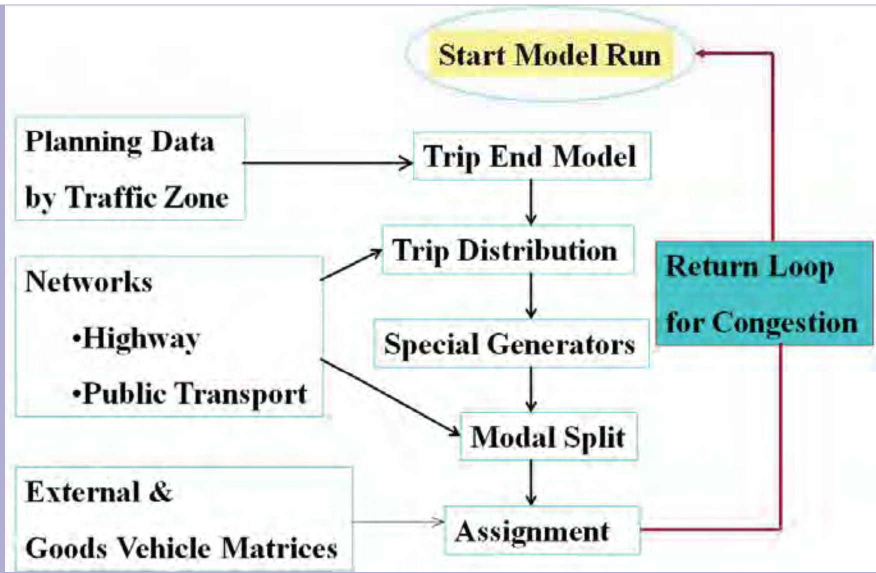
Model Flowchart



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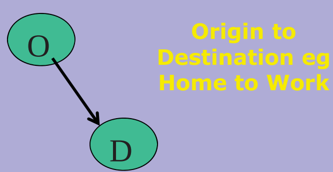
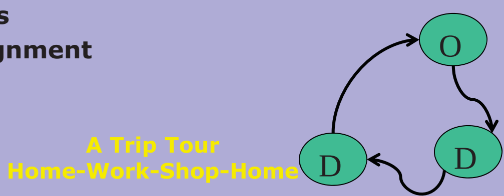
The Model- Classic or Activity Based

- **Classic Model**
  - Trip Generation
  - Trip Distribution
  - Mode split
  - Trip Assignment



- **Activity Based Model**
  - Trip Tours
  - Trip Assignment



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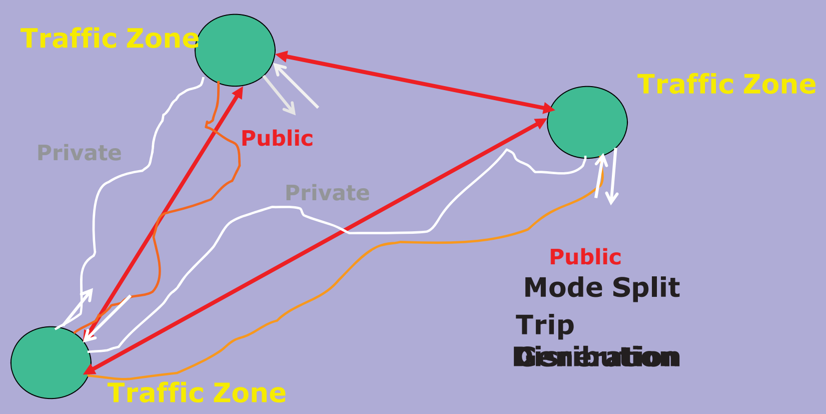
Transport Planning



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An Activity Based Model

Activity and Travel Simulator

Main loop on households

- Household car ownership model
- Loop on people in household
  - Full day tour/trip activity pattern choice models
  - Loop on tours in the day
    - Tour time of day choice models (both directions)
    - Tour main mode and destination choice models
    - Loop on trips in the tour
      - Intermediate stop location choice model
      - Trip mode choice (usually same as tour mode)
      - Write trip record (with tour, person and HH info)

TRIP TOURS AND ACCESIBILITY

6

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Example of Activity Based Trip Generation in Qatar

Group No.	HH Type	Age	CarAvailability	Income	Gender
1	Q	Adult			Male
2	Q	Adult	Available		Female
3	Q	Adult	Not Available		Female
4	NQ	Adult	Available	High	Male
5	NQ	Adult	Available	High	Female
6	NQ	Adult	Available	Medium	Male
7	NQ	Adult	Available	Medium	Female
8	NQ	Adult	Not Available	High	Male
9	NQ	Adult	Not Available	High	Female
10	NQ	Adult	Not Available	Medium	Male
11	NQ	Adult	Not Available	Medium	Female
12	NQ	Adult		Low	
13	Q	Pupil			Male
14	Q	Pupil			Female
15	NQ	Pupil			Male
16	NQ	Pupil			Female
17		Student			Male
18		Student			Female
19	Labourer	Adult	Available		
20	Labourer	Adult	Not Available		

Population Groupings

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Commercial Vehicle Forecasts

Types of Commercial Vehicles

- **Trucks –Freight Movements**
  ---Linked to Commodity Types
- **Delivery Vehicles**
- **Service Vehicles**

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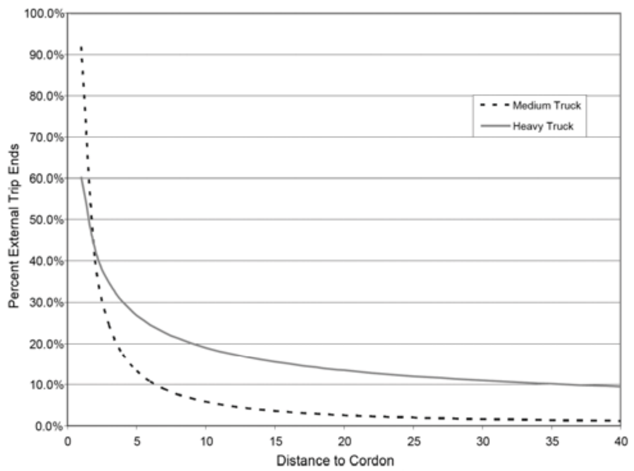
Example of External Vehicle Distribution



Percent External (MT) = $0.919 * D^{-1.2}$
Percent External (HT) = $0.602 * D^{-0.5}$,
where
D = distance to nearest external station (via highway net)

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Activity Chains in Qatar

- **Initially 937 Activity Chains**
- **10 Most Important Chains-84.2% of all trips**
- **56 Activity Chains included**
- **Maximum of 4 Legs within the Trip**
- **Represents more than 90% of Activity Chains**
- **Represents more than 90% of Trips**

Chain	Share(%)
H-W-H	34.2
H-M-H	14.6
H-E-H	10.9
H-S-H	10.4
H-PB-H	4.3
H-VF-H	3.6
H-L-H	2.5
H-EB-H	1.5
H-Eat-H	1.3
H-Uni-H	1.0

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Trip Chains per 100 People in each Population Category

Chain	Qatari Male	Qatari Female with Car	Qatari Female without Car	Labourer without Car
H-Mosque-H	42.64	3.32	0	29.4
H-Work-H	45.28	56.05	12.16	94.81
H-Visiting-H	15.57	20.99	8.19	2.68
H-PB-PB-H	8.83	8.14	0.75	0

With Activity Analysis, Production, Attraction and Distribution are estimated together.

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Project Evaluation

- Economic Evaluation
- Financial Evaluation
- Multi Criteria Analysis

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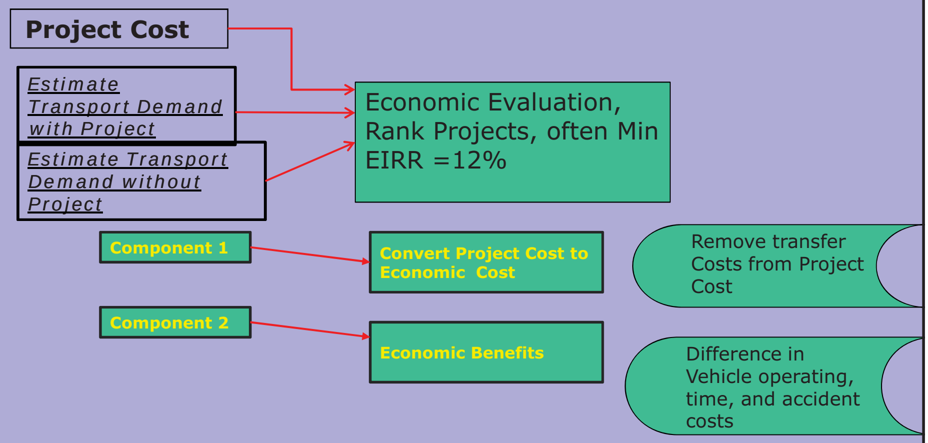
Economic Evaluation



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Economic Savings

- **Time Savings linked to change in Travel Time with and without Project, the travel time benefit is then linked to monetary units by the Value of Time.**
- **Vehicle Operating Cost Savings of Vehicles includes capital costs and operating costs**
- **Accident Cost savings.**

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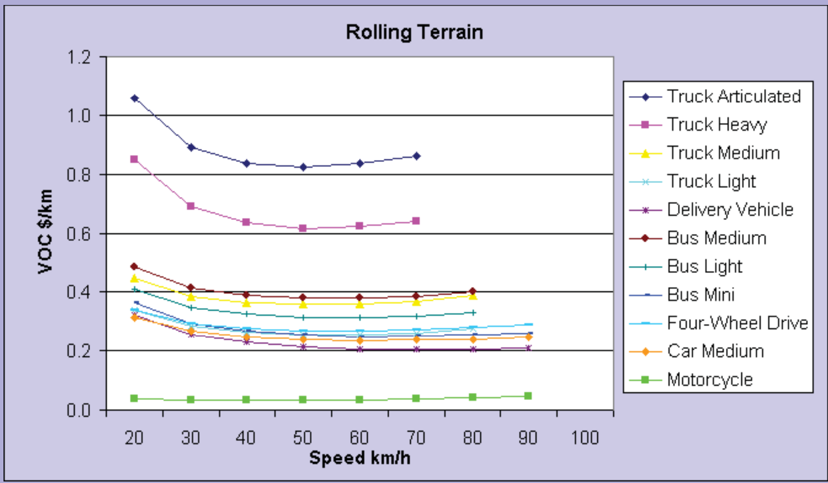
Vehicle Operating Costs



Source: World Bank for *specified gradient, curvature and roughness (IRI) value of 5.*

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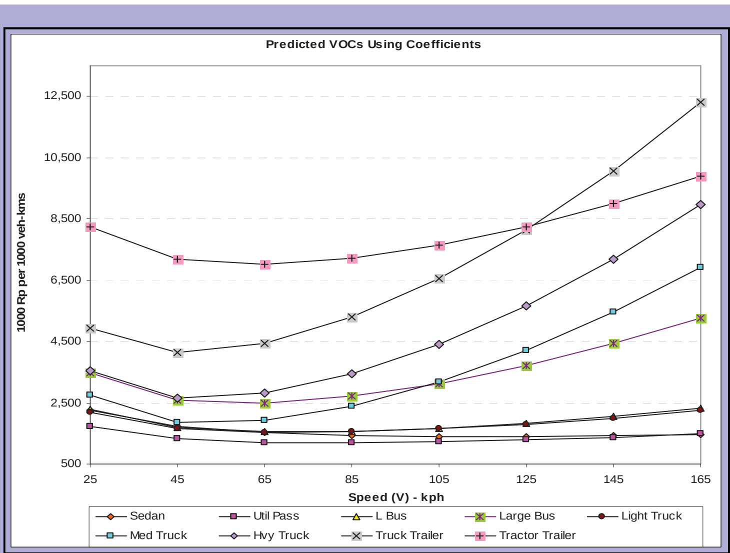
Vehicle Operating Costs in Indonesia



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Sample EIRR Calculation for a road Project

	Costs ($mill)				Benefits ($mill)					Net ($mill)
	Civil Works	Other Capital	Land & Resett.	O&M	Normal and Diverted		Generated		Accident Savings	
					VOC	Time	VOC	Time		
2009										
2010	171.94	9.04	21.00							- 201.98
2011	275.10	10.77	30.50							- 316.37
2012	318.08	13.29								- 331.37
2013	94.56	5.67								- 100.23
2014				4.57	57.69	33.23	- 5.13	- 1.36	- 0.79	79.06
2015				4.57	63.74	33.10	- 0.67	21.39	- 1.10	111.88
↓				↓	↓	↓	↓	↓	↓	↓
2030				4.57	158.43	56.56	52.85	400.68	- 5.20	658.76
2031				4.57	166.35	62.22	55.49	440.75	- 5.45	714.78
2032				4.57	174.67	68.44	58.27	484.82	- 5.73	775.90
2033	- 515.81			4.57	183.40	75.28	61.18	533.31	- 6.01	1,358.39
										7,771.69
							Economic Net Present Value ($mill)			639.20
							Economic Internal Rate of Return			18.3%

Economic Evaluation of Benefits Vs Costs over a 25 year period

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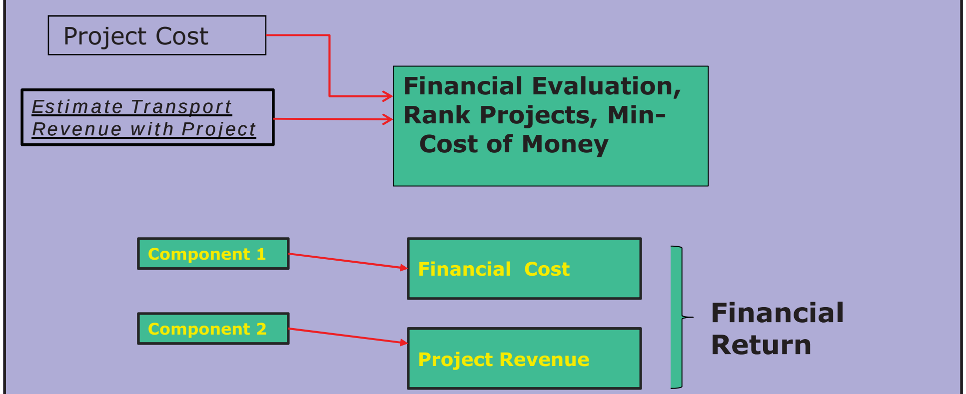
Financial Evaluation



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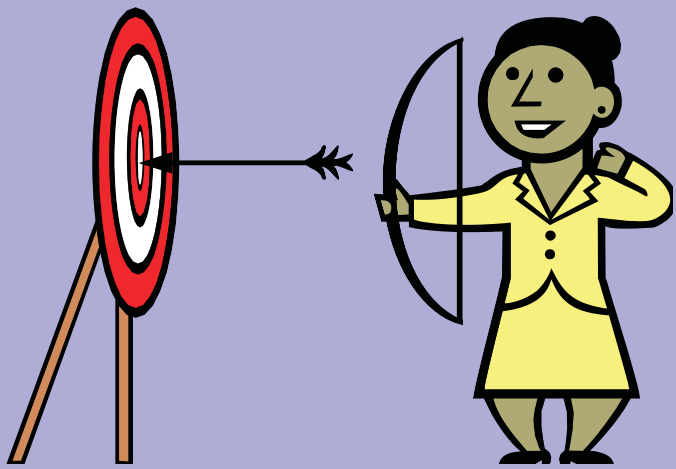
(Goal) Achievement (Matrix)
MULTI CRITERIA ANALYSIS



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MCA vs CBA

The economic rationale

The economic rationale is a consistent approach to investments where the preference for one or another alternative is consistent with maximizing utility.

Vs

The supportive rationale.

The supportive rationale, on the contrary, rejects the cyclic principle of means-end analysis and introduces the notion of supportive selection, by which the final selection of an alternative is defined by the support it receives and could therefore be other than the "logical" best solution

MCA is NOT "… a reaction against the limitations of the CBA technique, namely that with CBA all costs and benefits are expressed explicitly in monetary terms, it fails to incorporate intangible items in the actual calculations of a study area, …"

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Ranking and Prioritizing…

MCA is unacceptably "creative" by fabricating itself quantitative data and turning them into decisive information for the evaluation. Combining (multiplying) these "would-be quantified" data with "arbitrarily allocated" weights allows MCA to rank parameters according to its importance prior to the actual evaluation.

Although…

"…project examiner should check that these kinds of costs have been identified, quantified and given a realistic monetary value, if possible. If this is difficult or impossible this costs and benefits should be quantified at least in physical terms for a qualitative appraisal." (European Commission: "Guide to cost-benefit analysis", 1987)

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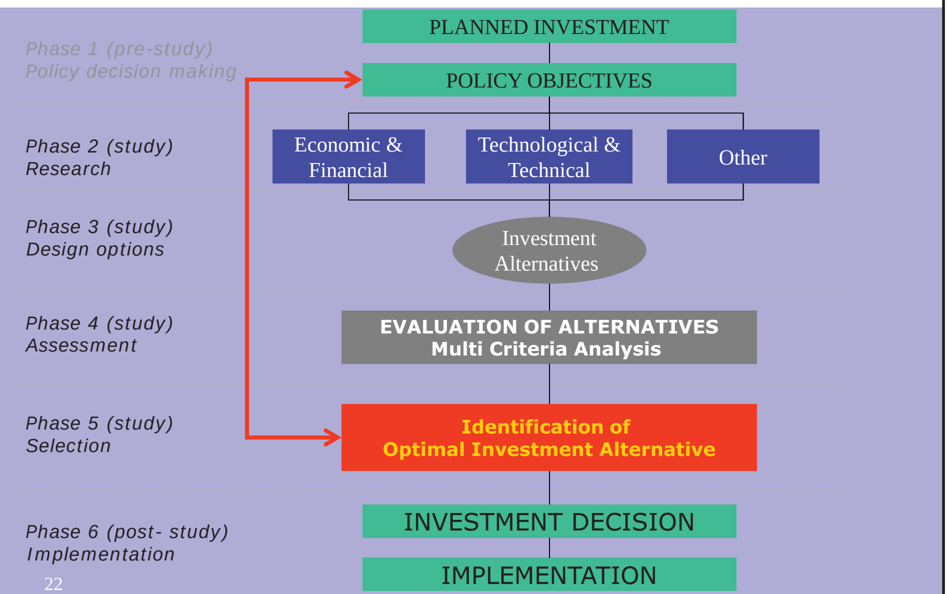
MCA as integral part of the process



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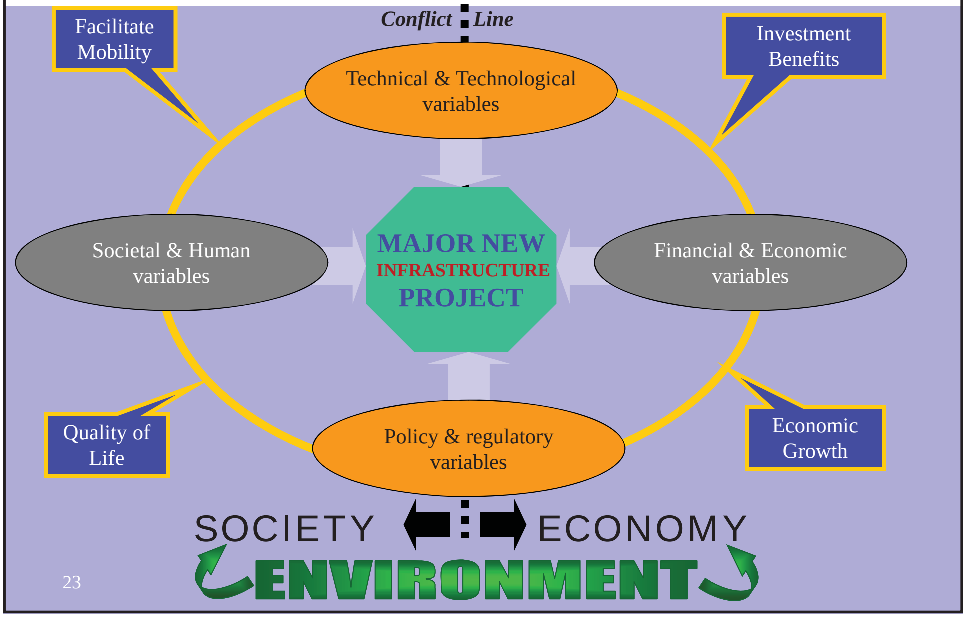
We need MCA...



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MCA Approach - Example

Strategy 1: Improvement of peoples mobility
- Integrated public transport system
- Traffic Demand Management

Strategy 2 Optimal infrastructure development
- Road transport
  - Regional Primary Highway Improvements
  - Primary Arterial Street Improvements
  - Secondary Arterial Street Improvements
  - Intersection Grade Separation Projects
  - Urban Expressway Projects
- Public transport
- Cargo Transport

Strategy 4: Accessible transport for all
- Traffic management and control
- Traffic safety strategies
- Environmental management

Strategy 5: Sustainable institutional and financial mechanisms
- institutional strengthening
- sustainable financial mechanisms
- Investment decision procedures
- human resources development
- improvement / restructuring of operators
- cargo transport sector restructuring

Strategy 3: Safe and comfortable transport
- Accessibility for all to public transport
- Targeted support for the poor
- Gender based sensitivity
- Handicapped accessibility

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MCA Approach (Example - Cairo)

Operational indicators
- Person demand
- Supply utilization
- Cargo transport facilitation

Socio-economic indicators
- Regional economic development
- Transport access
- Social integration

Performance indicators
- Improved governance
- Enhanced market mechanisms
- Public private partnership potential
- Knowledge based management

Implementation indicators
- Right of way
- Financing potential
- Project approval procedures
- Legal framework
- Stakeholder involvement
- Development cost
- Cost recovery potential

Environment and safety indicators
- Quality of life
- Aesthetics
- Transport safety

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MCA Evaluation scale (Cairo example)

Expert opinion rating (factual)

Criterion	++	+	N	-	- -
Implementation indicators					
Right of way	100% available	RoW needed but likely available from other infrastructure	More purchases for peripheral facilities	Some purchases for above ground projects (peripheral area)	Expensive purchases for above ground projects (Urban area)
Financing potential	Funding available	Funding partially available	Possible, but not yet available (or irrelevant)	Not available, small investment	Not available, large investment
Project approval procedures	Committed project	Process initiated	Favorable potential (or irrelevant)	Difficulties in approval	Low probability of approval
Legal framework	Legal framework changed or in place	Changes initiated	Irrelevant or not required	Not yet initiated (small changes needed)	Not yet initiated (major changes in Law required)
Stakeholder involvement	Single stakeholder	Single stakeholder, complex project	X	Multiple stakeholders	Multiple stakeholders, complex
Development cost	< 50000 / KM LOW	50000 - 75000 / KM MEDIUM LOW	75000 - 100000 / KM NEUTRAL (irrelevant)	100000 - 125000 / KM HIGH	> 125000 / KM VERY HIGH
Cost recovery potential	Profitable	Break even	< 70%	< 50%	No revenues

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MCA weight Settings

		weights	generic weight	Weighted value
	Operational indicators	**100%**	**20**	
1	person demand	40%		**8**
2	supply utilization	30%		**6**
3	cargo transport facilitation	30%		**6**
	Performance indicators	**100%**	**20**	
4	improved governance	40%		**8**
5	enhanced market mechanisms	30%		**6**
6	public private partnership potential	20%		**4**
7	Knowledge based management	10%		**2**
	Implementation indicators	**100%**	**20**	
8	Right of way	20%		**4**
9	financing potential	20%		**4**
10	project approval procedures	10%		**2**
11	Legal framework	10%		**2**
12	Stakeholder involvement	20%		**4**
13	Development cost	15%		**3**
14	Cost recovery potential	5%		**1**
	socio-economic indicators	**100%**	**20**	
15	Regional economic development	30%		**6**
16	transport access	30%		**6**
17	Social integration	40%		**8**
	Environment and safety indicators	**100%**	**20**	
18	quality of life	25%		**5**
19	Aesthetics	25%		**5**
20	transport safety	50%		**10**
			100	**100**

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MCA Evaluation (Cairo example)

Primary Arterial Street Improvements

Saft El Laban Axis	--	+	-	N	N	N	N	--	-	-	++	++	--	+	+	+	--	--	+	+
Rod El Farag Axis	--	++	--	N	N	N	N	--	-	-	N	++	++	--	+	+	+	--	+	+
15th May St. Extension	-	+	N	N	N	N	N	-	-	N	N	++	++	--	+	+	+	--	+	+
Ahmed Oraby St.	-	N	-	N	N	N	N	-	-	N	N	++	++	--	+	+	+	--	+	+
Moasaset El Zakah St.	--	-	-	N	N	N	N	+	-	-	N	++	++	--	+	+	+	--	+	+
Ain Sukhna-Nasr City Rd. Extension	--	--	--	N	N	N	N	-	-	-	N	++	++	--	+	+	+	--	+	+

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Itinerary

Counterpart Training Program

Stage 1 – Knowledge Building Stage

Day 1 - Session 3

1

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The Transport Model ??

- **Mathematical Representation of the movement of People and Goods in a defined Geographical Area whether it is a city, a region or a Nation.**

- **What do we mean by movement?**
  - **People Walking**
  - **People travelling by Private Vehicle**
  - **People travelling by Transit**
  - **Goods travelling by Truck**
  - **Service Vehicles**

2

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Why????????---THIS IS WHY?

- Proposed Alternative Transport Solutions
- Limited Resources
- Evaluate Best Use of Resources
- Rank Projects

3

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WHAT IS NEEDED FOR THE MODEL DEFINITION ??

Transport Database

Software

Model Development

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The Database

TRANSPORT PLANNING SURVEYS

- Home Interview Surveys
- Traffic Counts
- Roadside Surveys
- Commuter Surveys
- Special Generator Surveys
- External Cordon Surveys
- Infrastructure Inventory Surveys

TRANSPORT PLANNING DATABASE

DEMOGRAPHIC DATA

- Population
- Number of Households
- Household Income
- Employment
- Student Enrolments

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Background of the Transport Model

- Zoning System
- Trip Purpose
- Trip Generation
- Trip Distribution
- Modal Split
- Assignment
- Calibration

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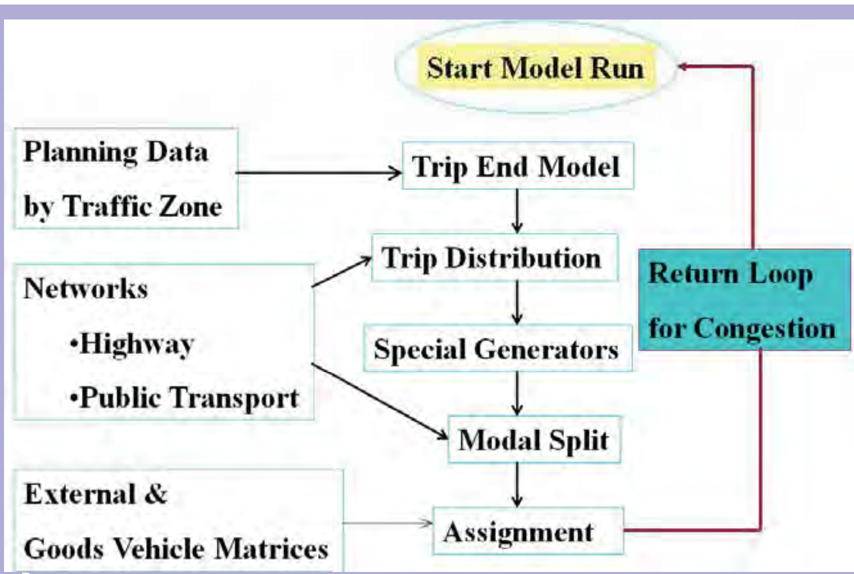
Model Flowchart



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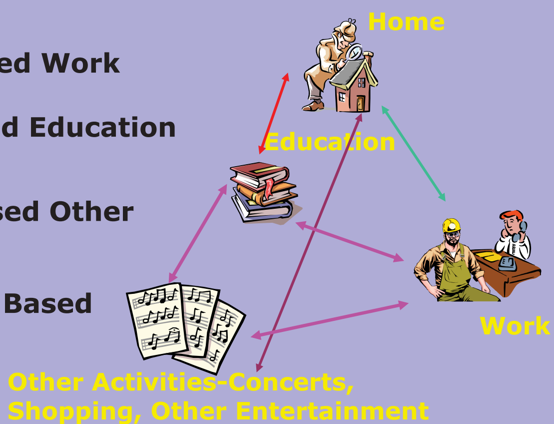
Trip Purpose

HBW – Home Based Work

HBE – Home Based Education

HBO – Home Based Other

NHB – Non Home Based



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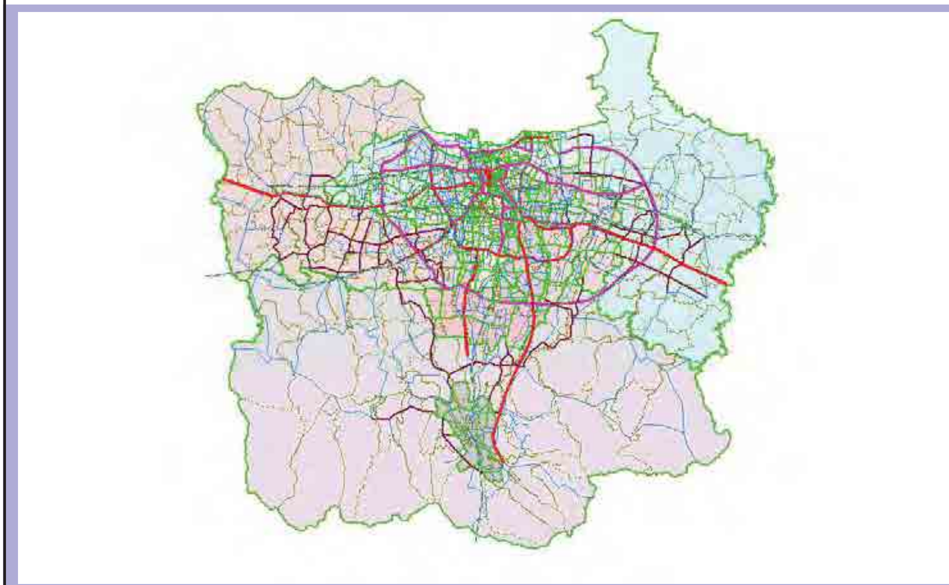
Zone System in Jakarta



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Zone System in Jakarta

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Trip Generatuion and Attraction Model - Trip Rate Model

- **Trip rate model**
  - **Just multiplying trip rate and zonal indicator such as population or area.**
  - **Trip rate is the number of generation or attraction per a person or unit area such as 1km².**

$$G_i = \alpha X_i$$
$$A_j = \beta X_j$$

where:

G_i: **Trip generation of zone** i

A_j: **Trip attraction of zone** j

X_i, X_j: **Zonal indicators**

α, β: **Trip rate**

Example of Trip rate in Jakarta

Area	Gross Trip Production Rate*
DKI Jakarta	2.21
Bodetabek	1.74

Source: SITRAMP Phase 2, 2004, (Based on 2002 Survey data)

*Gross trip rate is calculated by dividing total number of trips by number of residents aging 5 years old and more.

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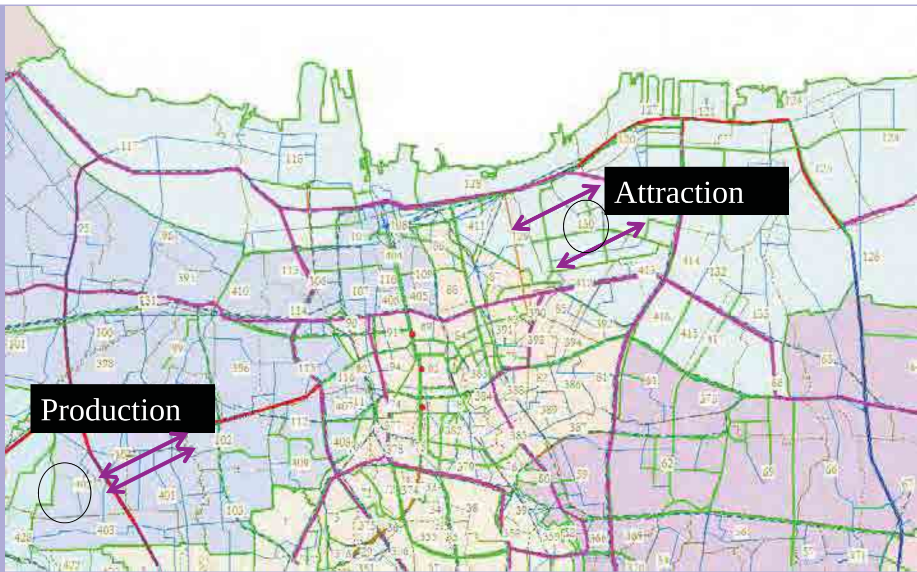
Productions and Attractions



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Trip Generation and Attraction Model – Regression Model

- **Estimate trip generation / attraction from simple regression model based on past survey data.**
- **Examples of variables include population, working population.**

$$G_i = \alpha_0 + \sum_n \alpha_n X_{n,i}$$

$$A_j = \beta_0 + \sum_n \beta_n X_{n,j}$$

where:
$X_{n,i}$ $X_{n,j}$: Zonal indicators
α, β: Parameters

- Example in Jakarta (Home to work trip production model for middle income group)

G = 245.26 + 0.5132 * *JOB1M* + 0.9977**JOB2M* + 0.8390**JOB3M*

where;
JOB1M: Number of middle-income workers in the primary sector at working place
JOB2M: Number of middle-income workers in the secondary sector at working place
JOB3M: Number of middle-income workers in the tertiary sector at working place

Source: SITRAMP Phase 2, 2004 , (Based on 2002 Survey data)

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Trip Gen & Atr Model - Regression Model & Variables

- **Regression model have to;**
  - **Logically explainable**
  - **Predictable variable for the future**
  - **Strong correlation with the object**
- **Example of variables for trip generation and attraction model**

Generation Model

- Population
- # of students at resident place
- # of workers at resident place

Attraction Model

- # of employees by industrial sector at working place
- # of schools
- Floor area by business type

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Trip Gen&Atr Model –Growth and Control Total Check

- **Growth model**
  - o Present pattern method
- **Forecast is often done by personal attributes, trip purpose, transportation mode. Future production by group is sometimes not accurate.**
- **Adjusting to control total volume (trip production of all personal attributes, trip purpose and transportation mode) is important.**

$$t_k' = t_k\left(\frac{T}{\sum_k t_k}\right)$$

where:
T: Control total trip production
t_k: The number of trip of group k (attributes, purpose, mode)
t_k' : Adjusted trip number

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Trip Generation – Trip Production ~~ Cross Classification

Trip Production Rate for Each Disaggregate Group

	HOUSEHOLD SIZE			
Income Class	1	2	3	4 etc
1	??	??	??	??
2	??	??	??	??
3	??	??	??	??

Each Cell has a Trip Generation Rate Per Household

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The Bangkok Trip Generation Cross Tabulation

- **The Matrix of Cross Classification by Income and Household Size**
- **Equations developed from Major Surveys**

Vehicle Groupings or Income

Household Size 1-6

211	64	61	3	0
840	367	344	69	1
949	417	498	163	20
741	403	495	231	40
315	143	235	144	36
286	258	174	240	129

Total Number is 7,877

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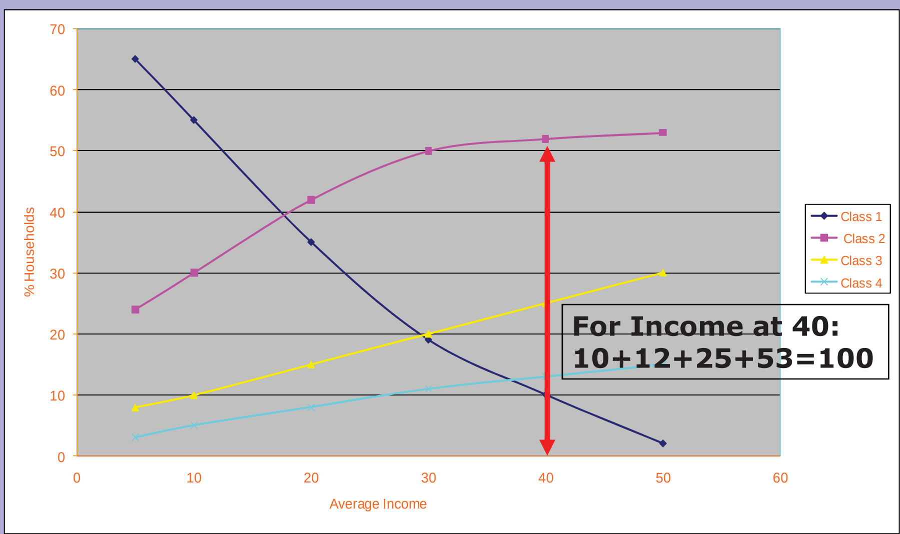
Vehicle Ownership Classification Cross Classification



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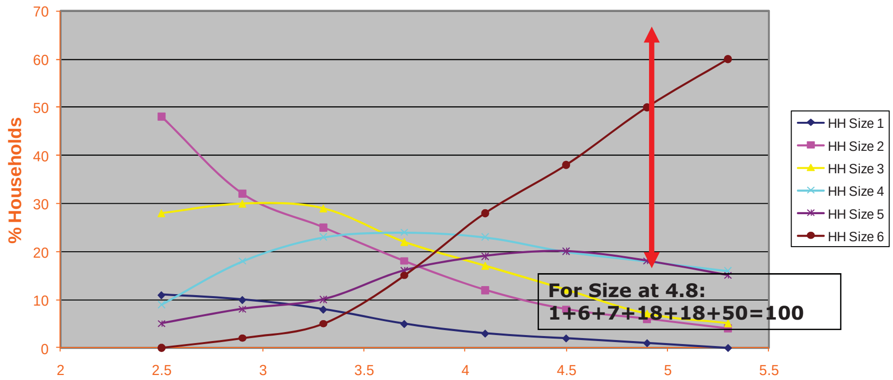
Distributions of Households by Household Size



All Best Fit Curves of the Form: Average Household Size
of polynomial best-fit curves of the order of 5. The curves take the following form:

$y = ax^5 + bx^4 + cx^3 + dx^2 + ex + f$ where
y is the percentage of households in a given grouping;
x is the zonal average of household income or household size; and
a, b, c, d, e, and f are calibration constants.

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Trip Rates are developed in each cell by Trip Purpose

HOUSEHOLD TRIP Rates, Person Trips per Household

Vehicle Groupings or Income

Household Size 1-6

0.57	0.81	0.8	1.09	1.09
1.2	1.42	1.25	2.04	2.62
1.48	1.67	1.42	2.55	3.27
1.84	1.83	1.67	3.11	3.99
2.31	2.54	1.88	3.51	4.64
2.85	2.98	2.06	4.06	5.36

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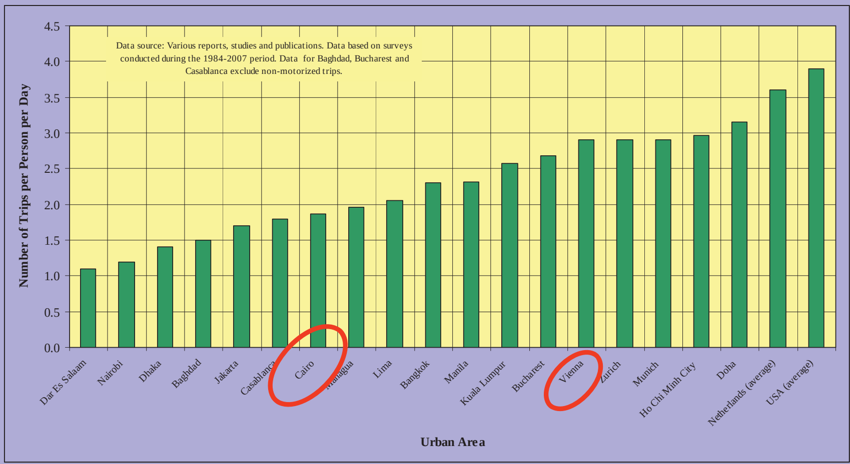
International Trip Generation Rates



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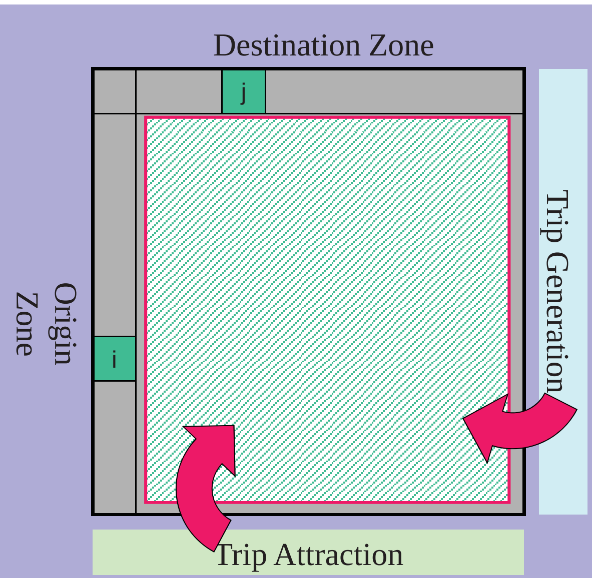
Trip Distribution



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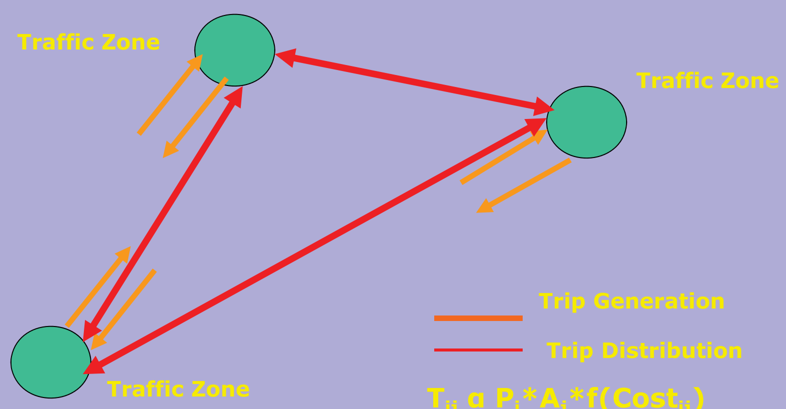
TRIP DISTRIBUTION



Trip Generation

Trip Distribution

T_{ij} α P_i*A_j*f($Cost_{ij}$)

↑

F Factor

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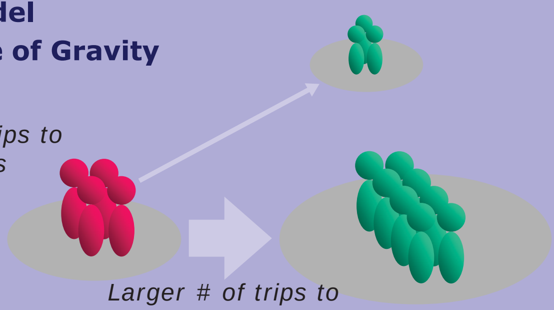
Trip Distribution
– Distribution Model

Gravity Model

- **Image of Gravity Model**

Smaller # of trips to further and less attractive area



Larger # of trips to nearer and more attractive area

$$T_{ij} = k\frac{(P_i\ A_j)^{\alpha}}{(d_{ij})^{\beta}}$$

where:
k, α, β: parameter
d: Distance, Travel time or Generalized cost

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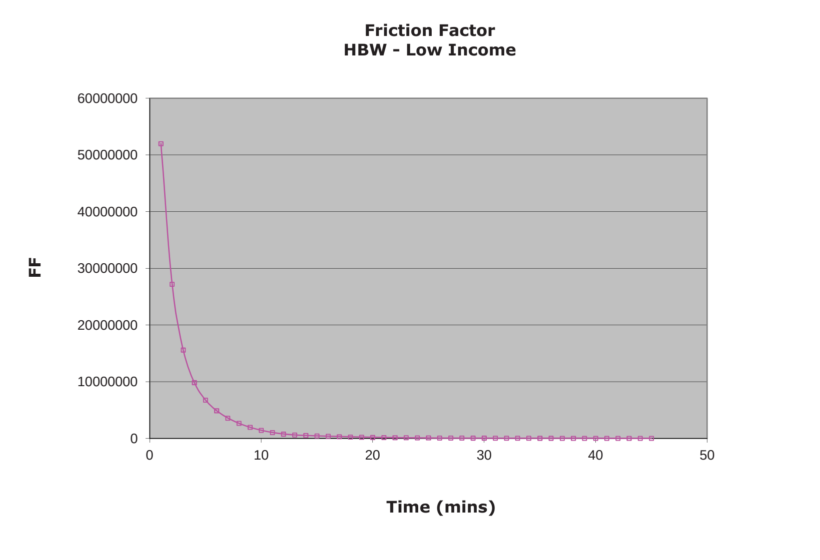
Typical F Curve



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Trip Distribution – Equation

$$T_{ij} = P_i \frac{A_j f(c_{ij}) K_{ij}}{\sum A_j f(c_{ij}) K_{ij}}$$

where:

$f(c_{ij})$: F Factor, a function cost of travel

P_i: Productions at zone i

A_j,: Attractions at zone j

T_{ij}: Trips between zone i and zone j

K_{ij}: Parameter which describe relation between zones. Difference of surveyed OD traffic volume and estimated OD traffic volume is usually used.

(Plus calibration constants not shown here)

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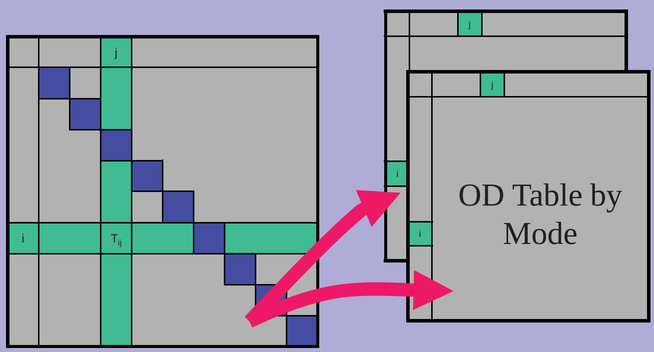
Mode Split



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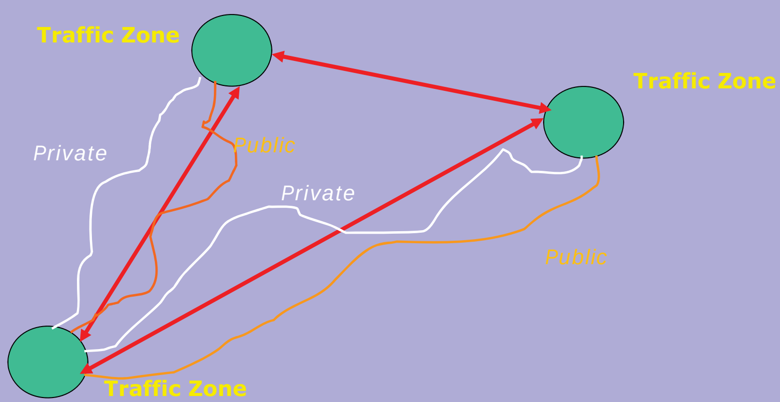
Mode Split



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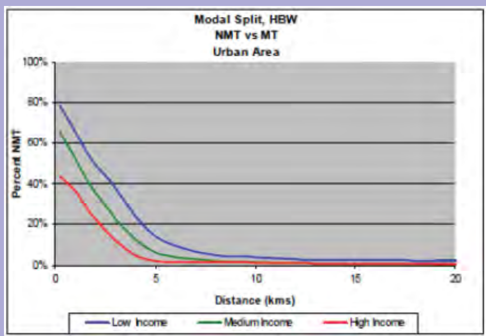
Modal Share Method

- **Diversion Curve Method**
  - Conventional method, but only one variance is considered for calculating modal choice.
  - Distance, difference of travel time by transportation mode and ratio of travel time by transportation mode are used for variance.

- **Aggregated Model**
- **Disaggregated Model**



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Aggregated / disaggregated model

- **Aggregated model**
  - **Estimating Zonal Mode Share**

mode (J) is more than 2

$$P_i = \frac{\exp(U_i)}{\sum_{j=1}^{J} \exp(U_j)}, i = 1, \ldots J$$

where:
P_i: Modal share of mode i
U: systematic term of Utility or Cost
J: # of transit. modes

mode (J) is 2

$$P_i = \frac{e^{U_1}}{e^{U_1} + e^{U_2}} = \frac{1}{1 + e^{U_2 - U_1}}$$

- **Disaggregated model**
  - **Estimating probability of choosing mode by individuals.**
  - **Modal share is calculated by sum of individual choice.**

$$P_n(i) = \frac{\exp(U_{in})}{\sum_{j=1}^{J} \exp(U_{jn})}, i = 1, \ldots J$$

Where: n: Individual

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Disaggregated Model

- Discrete Choice Model
  - o Focusing choice of mode of individuals
- Model structure
  - o Binary choice model
  - o Multi nominal choice model
  - o Nested choice model
- Model function
  - o Logit model
  - o Probit model

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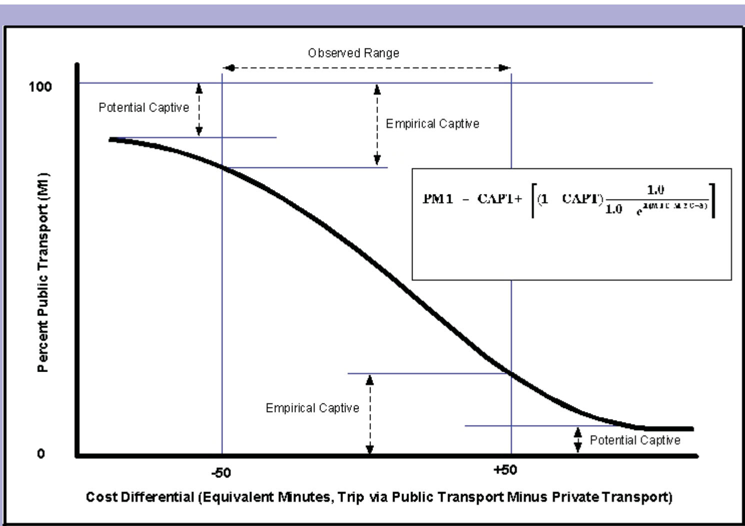
Typical Mode Split Curve



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What is Generalised Cost?

- **Car Trips**
  - **Travel Time**
  - **Out of Pocket Costs (Fuel and Toll)**

- **Public Transport Trips**
  - **Travel Time**
  - **In Vehicle Time**
  - **Wait Time**
  - **Walk Time**
  - **Transfers**
  - **Out of Pocket costs**
  - **Fare**

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Disaggregated Model - Model Structure

- Binary Logit model

$$P_n(i) = \frac{e^{U_{1n}}}{e^{U_{1n}} + e^{U_{2n}}} = \frac{1}{1 + e^{U_{2n} - U_{1n}}}$$

  - Model for binary choice (2 mode)
  - Since model function is very simple, calculation is easy.
  - i.e.. Motorized transportation and non-motorized transport
  - i.e.. Public transportation and private transportation

- Multinominal Logit model

$$P_n(i) = \frac{\exp(U_{in})}{\sum_{j=1}^{J} \exp(U_{jn})}, i = 1,...J$$

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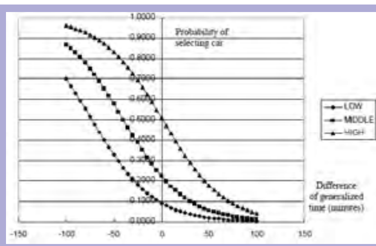
Aggregated Model in Jakarta

$$P_{car} = \frac{1}{1 + e^{U_{car} - U_{bus}}}$$

where:

$$U_{car} - U_{bus} = \beta (T_{car} - T_{bus}) + C$$



where:
U = Utility
T = generalized time (total composite time expressed in minutes)
C = constant

P_{car} = Probability of using Car
U_{car} = Utility of Car
U_{bus} = Utility of Busway

Income Group	β	Constant
Low	0.031367	2.28757
Middle	0.031367	1.24977
High	0.031367	-0.03471

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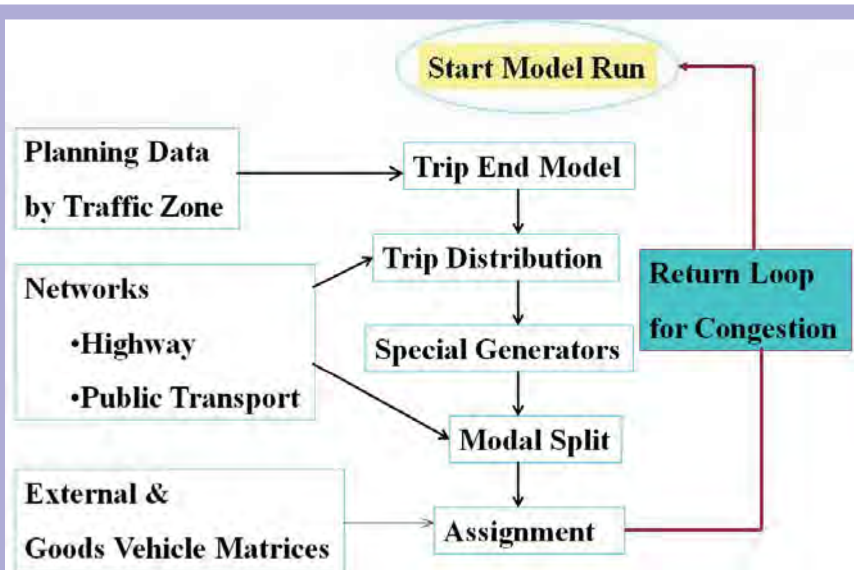
Trip Combination



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After completion of Mode Split

---- Several Trip Tables by Mode, Purpose, and
Vehicle Ownership or Income Class

These must be combined to produce trip tables or matrices for assignment to the network.

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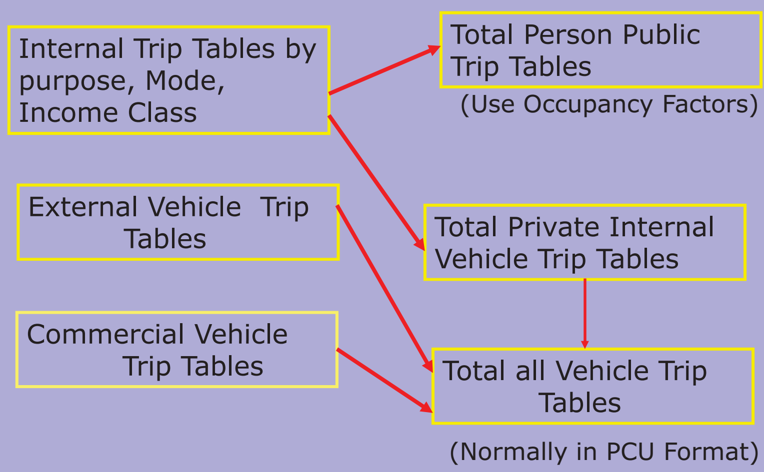
Trip Combination



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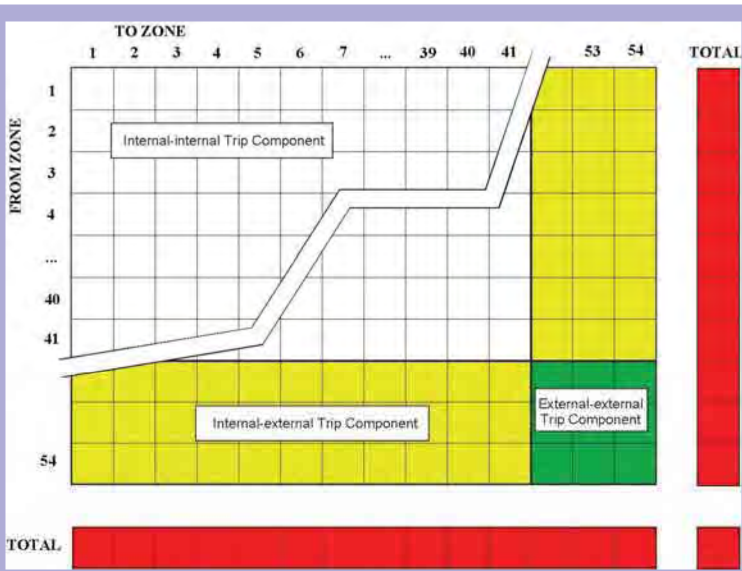
A Trip Table



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Prior to Assignment

Person Trip Tables using Public Transport → Total Person Public Trip Tables assigned To the Public Transport Network

Vehicle Trip Tables → Total Vehicle Trip Tables assigned to the Road Network

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Commercial Vehicles

- Before we continue to look at the Assignment procedure
- Need to add the other part of the travel picture
- Commercial Vehicles
- Freight and Service Vehicles
- Combine Commercial Vehicles
- Often Modelled in the form of Light, Medium and Heavy Vehicles

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Freight Demand Forecast

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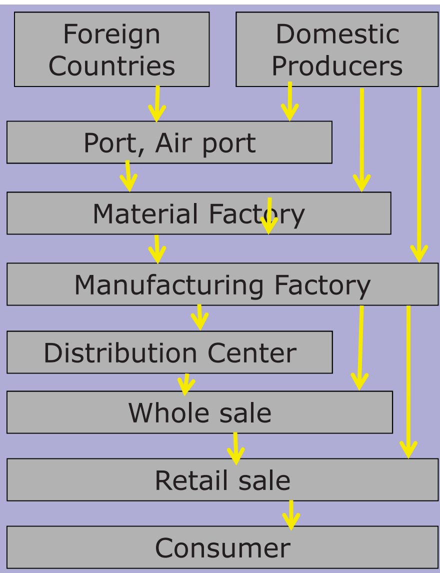
Freight Demand Forecast – Flow of Commodities

- The figure shows example of commodity flow of manufacturing sector.
- Materials and goods travel all over the region, nation and the world.
- Planners have to pay attention to ease the movement of all the level of movement.



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Major Features of Freight Transportation

- For freight transportation analyses, movement of commodities have to be surveyed instead of home interview survey.
  - o National level survey
  - o Urban area survey
- Since there is variety of trend by commodity type, freight traffic volume have to be analyzed based on commodity type.
- Although freight data is hard to obtain in Indonesia, survey at weigh bridge will be helpful to understand the commodity flow.

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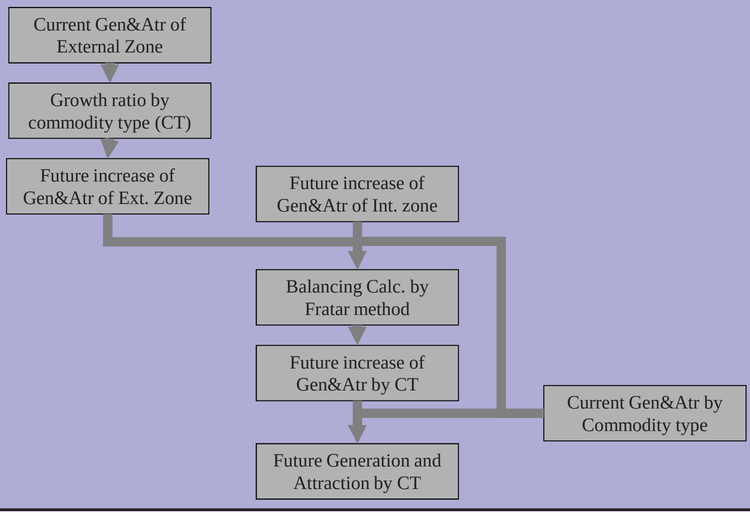
Freight Volume Calculation Process

– Example of estimation of freight distribution in Tokyo Metropolitan Area



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Service Vehicles

- **For Example**
  - Trade Vehicles
  - Delivery Vehicles
  - Maintenance Vehicles
  - Courier Vehicles
- **Modelled as Tours of a city**
  - Not necessarily large in numbers
  - Made up of mainly light trucks

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Traffic Assignment Method-- Vehicles

- All or Nothing Assignment
- **Incremental Assignment**
- **User Equilibrium Assignment**
- Dynamic traffic Assignment
- Stochastic traffic Assignment

Prior to the Road Assignment, there is normally a preload on the network of Road Based Public Transport --- Impact is to REDUCE ROAD CAPACITY

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Summary of Traffic Assignment

- Input
  - OD table, network (road / public transportation), link performance function, toll road data
- Output
  - Link traffic volume (v/c ratio), link travel speed, route etc.
- Principles of Traffic Assignment by Wardlop
  - 1. "*The journey times in all routes actually used are equal and less than those which would be experienced by a single vehicle on any unused route.*" -> All the drivers from one origin to another destination take same time even if they take different route.
  - 2. "*At equilibrium, the average journey time is minimum.*"
  - 1^{st} principles are basics of current user equilibrium assignment.

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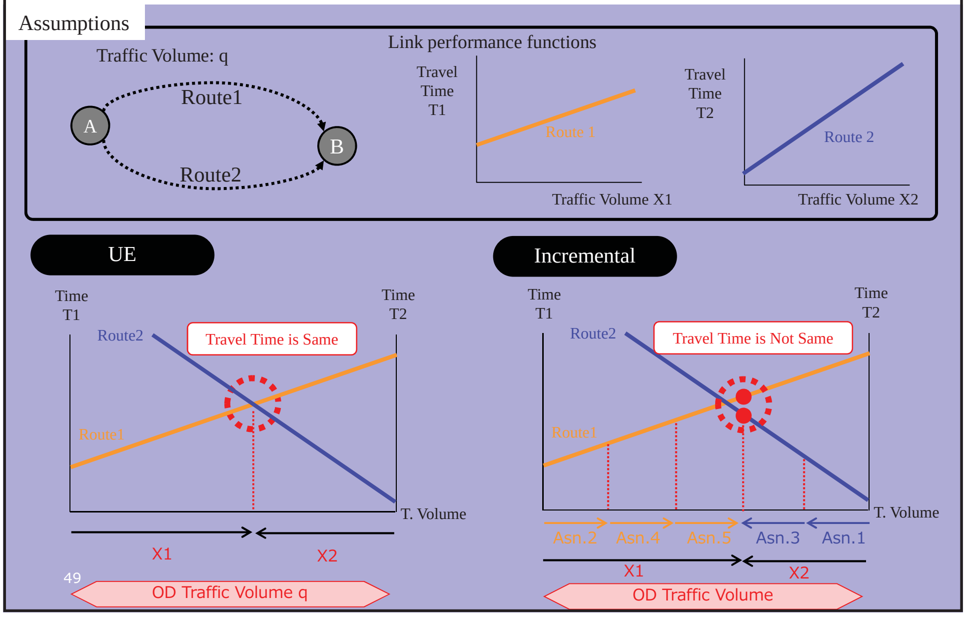
Incremental and User Equilibrium (UE) Assignment



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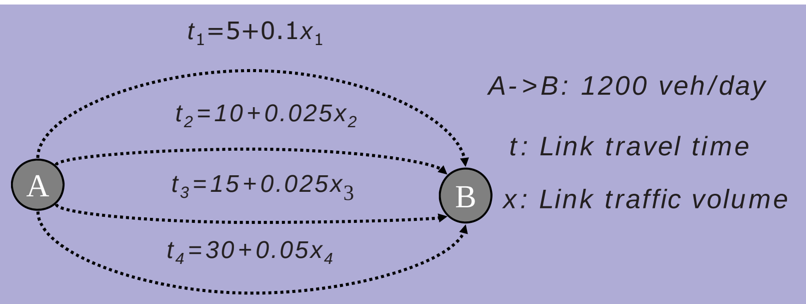
Example of User Equilibrium



A->B: 1200 veh/day

t: Link travel time

x: Link traffic volume

Link	*x*	Equation	*t*
1	200	5+0.1*200=	25
2	600	10+0.025*600=	25
3	400	15+0.025*600=	25
4	0	30+0.05*0	(30)

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Link Performance Functions (Delay Function)

- Incremental Assignment
  - Q-V function
- User Equilibrium Assignment
  - BPR function
  - Davidson's Formula

$$t_a(x_a) = t_{a_0}\left\{1+\alpha\left(\frac{x_a}{C_a}\right)^{\beta}\right\} + \frac{\xi_a}{\omega}$$

where,

t_a :Travel time of link *a*

t_{a0} :Free Travel time of link a. (travel time without traffic)

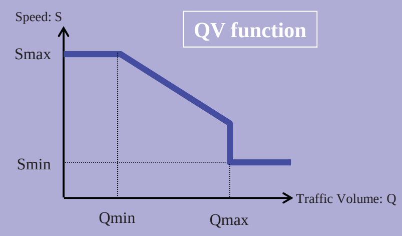
x_a :Traffic volume of link *a*

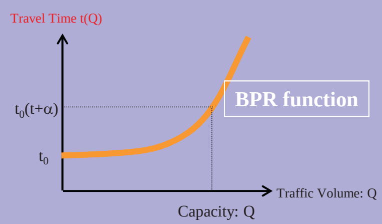
C_a :Capacity of link *a*

ξ_a :Toll of link *a*

ω :Time value

α,β :Parameters





BPR Formula: TC[1] = T0 *(1 + 0.15 * $(V/C)^4$)

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where,

t_a :Travel time of link *a*

t_{a0} :Free Travel time of link a. (travel time without traffic)

x_a :Traffic volume of link *a*

C_a :Capacity of link *a*

ξ_a :Toll of link *a*

ω :Time value

α,β :Parameters

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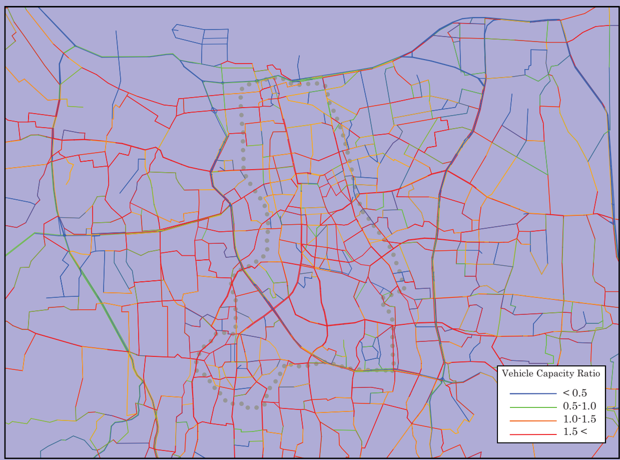
Example output in Jakarta

Jakarta Road Network



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Public Transport Assignment

- Binary Mode Split
  - Distribution between Modes is undertaken during Mode Split
- Multimodal Mode Split Equation
  - Assignment to Public Transport Mode

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Public Transport Inputs

- A highway or public transport network
- Public transport system data
- Line data
- Fare data
- Non transit legs
- Generalized cost information
- Demand

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Public Transport Outputs

- Non transit legs
- Enumerated routes
- Skim and select-link matrices
- Loaded lines and Non transit legs
- Transfer matrices—results of loading analyses
- A variety of reports of input data and model results
- A public transport network that can be displayed by Cube and used as an input network for further modeling

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PT Assignment

- Best Path
- Assigns all trips between any Origin and Destination to the Best Path Only
- Multipath
- Evaluate multiple routes and calculate the probabilities of using each one.

- *Assignment is often done for Multiple Income Classes*
- *EG some classes may be banned from the higher order transport modes*

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Multi Path PT Assignment

- Split between modes at decision points eg

Probabilities of the individual lines in proportion to their frequency. The model is equivalent to travelers who arrive randomly without knowledge of the timetables and take the first reasonable service forward from the node.

where:

$$P_{Use\,Line\,l} = \frac{Frequency_{Line\,l}}{\sum_k Frequency_{Line\,k}}$$

Probability (to use line l) is the probability of using line l.
Frequency(line l) is the frequency of line l (in services per hour).
Frequency(line k) is the frequency of line k (in services per hour).

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Calibration

- Verify Traffic Assignment on Roads against traffic counts by various class of vehicle
  - On Individual links
  - Across Screenlines
- Verify Passenger Travel
  - Total number of passengers via various modes
  - Passenger Flows across screenlines

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What do you look for in the calibration procedure?

- Accuracy across Screenlines such as a Natural Barriers.
- Accuracy of Individual Links.
- Accuracy of Individual Modes such as the Mass Transit and Individual Bus Lines

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