CHAPTER 12

TRAFFIC DEMAND FORECAST

CHAPTER 12 TRANSPORT DEMAND FORECAST

12.1 METHODOLOGY

(1) Traffic Study Area

As described in Chapter 10, the Study Area, which consists of the Nairobi City and its surrounding areas, has been split into 153 small zones, 73 medium zones, and 15 large zones, of which 104 small zones, 50 medium zones, and 8 large zones are in the Nairobi City. Traffic Study Area is basically the same as the Nairobi Metropolitan Area, although the Person Trip Survey has been conducted only within the Nairobi City. Therefore, certain distinct processes cover only the Nairobi City.

(2) Four Steps Approach

Consideration of the urban area throughout Nairobi City is necessary as a base to precisely determine transportation investment decisions regarding comprehensive, coordinated, and continuing transportation planning process. A significant element of the transportation planning process involves projecting future transportation demand. The most acceptable method of projecting future transportation demand, and for evaluating investment strategies to serve the projected demand, is the use of travel demand and forecasting models. In this case the models have utilized socio-economic data that was presented in Chapter 11 to estimate travel demand coupled with a simulation of the transportation system to represent transportation supply. Together with this socio-economic data, the simulated transport network, and mathematical travel models simulate the ability of the transportation system to serve the estimated demand.

Travel models have been implemented by using a wide variety of model structures, computer software systems, and data sets. While it is rare to find two models that have identical model structures, software, and data sets, the majority of travel models applied in world wide are similar in that context. They include the following basic four steps or components:

i. Trip Production - the prediction of trips generated and attracted to each zone;
ii. Trip Distribution - the prediction of origin-destination flows, the linking of trip ends predicted by trip generation;
iii. Modal Split - the estimation of percentages of trip flows made by each transportation mode in the model; and
iv. Trip Assignment - the allocation of trips to routes in the transportation network.

The four stages represent a sequential decision structure.

(3) Zone System in Study Area

The model predicts trips over the transportation network based on attributes of traffic analysis zones developed in Chapter 10. Zonal attributes used in trip production include population and employment. A key component of the model development process was the development of the zone system to cover the Study Area.

The Study Area is defined from zones 1 to 104 in traffic survey zoning system, and outside the Study Area is defined from zones 105 to 200. To secure accuracy of modeling and forecasting, original survey zone system, composed from 104 zones, is grouped into traffic analysis zone system (TAZ) forming 50 zones

(4) External Zone Transportation Demand

Traffic that enters or leaves the modeling area around its perimeter is not specifically included in the four steps approach as outlined above. The modeling area contains 16 locations where the road network connects with the "outside modeling area". It is imperative that internal/external interactions are accounted for at these locations.

Traffic count data from the cordon line survey at the external stations provides the total volume of traffic that constitutes the internal/external interaction, although some portion of the traffic volume at these locations merely passes through the modeling area without an internal origin or destination. Those "pass-through" trips are called external-to-external (E-E) trips, the remaining portion of total traffic has an internal origin or destination and is classified as either external-to-internal (E-I) or internal-to-external (I-E) trips.

(5) Modeling and Forecasting Tools

In all steps of travel model calibrations and demand forecast, TRANSCAD system and EXCEL spread sheet are employed. TRANSCAD is a geographic information system designed specifically for planning, managing, and analyzing transportation systems. The software provides a set of tools for travel demand modeling as well as capabilities for geographic database management, presentation graphics and transportation models. TRANSCAD system is applied for simulation of travel time and cost. For better precision, efficiency and minimization of trial errors, model calibrations and forecasts in trip generation, trip distribution and modal split steps are programmed by using Excel spread sheet, and the final step, traffic assignment stage is computed by TRANSCAD system.

(6) Trip Purpose Classifications

Trip production is a step in the modeling process that utilizes the socio-economic data to calculate the trip making characteristics (person trips) of each zone that will eventually be

modeled on the road network. In this process, person trips are classified into four main trip purposes grouping from eight categories of the person trip survey as follows:

i. To Home Trips (HOME)
ii. To Work Trips (WORK)
iii. To School Trips (SCHOOL)
iv. Others Trips (OTHERS)

These trip purposes are consistent with the transportation model and allow travel characteristics associated with each feature to be quantified separately in many different aspects as shown in Table 12.1-1.

TABLE 12.1-1 TRIP PURPOSE CATEGORY IN DEMAND FORECASTING

Trip Purpose Category in Person Trip Survey		Trip Purpose Category in Demand Forecasting	
1	To Home	1	HOME
2	To Work	2	WORK
3	To School	3	SCHOOL
4	Personal Business	4	OTHERS
5	Firm Business		
6	Social		
7	Shopping		
8	Others		

(7) Travel Mode Classifications

To secure enough samples and accuracy for the modal split stage, original travel modes in the person trip survey are joined into analysis travel mode system, which consists of three categories as shown in Table12.1-2.

TABLE 12.1-2 TRAVEL MODE CATEGORY IN DEMAND FORECASTING

Travel Mode Category in Person Trip Survey		Travel Mode Category in Demand Forecasting	
1	Walking	1	WALK
2	Bicycle		
3	Motor Cycle		
4	Tricycle		
12	Others		
8	Taxi	2	PRIVATE
9	Private Car		
11	Truck		
12	Trailer		
5	Matatu	3	PUBLIC
6	Metro Shuttle		
7	Bus		
10	School/ Company/Tourist Bus		
13	KR (Railway)		

12.2 FORECASTING TRIP PRODUCTION

(1) Modeling Trip Rate per Person

In the analysis of trip rate per person obtained from the person trip survey conducted, a personal occupation is the most weighted attribute. In this case, the employee's rate 2.57 trips per day, the highest, while that of a student is 2.23, and un-employee is 1.36.

Cross-Classification methods of calculating trip productions can separate the population in a study area into relatively homogenous groups based on certain socio-economic characteristics. Considering the influence by the futuristic change in economic trend and life style in regard to trip production, especially in reference to the increase in labor force along with the economic growth, the trip rate per person modeled by Cross-Classification method by occupation is shown in Table12.2-1.

TABLE 12.2-1 TRIP RATE CLASSIFICATION TABLE

Unit: Trip per Person per Day

Occupation	Trip Purpose				
	HOME	WORK	SCHOOL	OTHERS	TOTAL
Employee	1.1745	0.9184	0.0246	0.4507	2.5682
Student	1.0769	0.0471	0.8193	0.2824	2.2257
Un-employee	0.6403	0.1878	0.0230	0.5067	1.3577
Total	1.0455	0.5622	0.2201	0.4191	2.2468

(2) Future Framework and Trip Rate

Based on future socio-economic prediction presented in Chapter 11, the total framework developed is summarized in Table 12.2-2. Future trip rates forecast by the trip production models derived from future occupation are 2.33 trips per person in 2010, 2.35 in 2015 and 2.36 in 2025 as shown in Table 12.2-3.

TABLE 12.2-2 FUTURE FRAMEWORK

	2004	2010	2015	2025
GRDP per capita(Nairobi) (at 1982 constant prices: KSH)	19,040	22,080	25,590	34,390
GRDP per household(Nairobi) (at 2004 constant prices: KSH)	32,600	37,805	43,815	58,882
Number of Household	889,317	1,028,675	1,131,492	1,391,838
Car ownership rate per household	23.3%	31.1%	41.3%	49.2%
Number of private car(Nairobi)	207,339	319,428	467,740	684,833
Population 5 & above	2,143,254	2,540,716	2,834,559	3,507,666
Student at enrolment place base	1,258,802	1,603,787	1,804,838	2,273,343
Worker at office base	517,825	620,510	707,122	877,545
Un-employee	366,627	356,777	322,599	316,419

TABLE 12.2-3 TRIP RATE BY HOUSEHOLD CAR OWNERSHIP

Year	Trip Purpose				
	HOME	WORK	SCHOOL	OTHERS	TOAL
2004	1.0455	0.5622	0.2201	0.4191	2.2468
2010	1.0842	0.6146	0.2185	0.4165	2.3338
2015	1.0894	0.6179	0.2227	0.4151	2.3450
2025	1.0958	0.6261	0.2233	0.4143	2.3594

(3) Future Total Trip Production

Based on the Cross-Classification trip rate table and the total future framework, the total trips production in the whole Study Area is forecasted to expand to 8.28 million trips per day in 2025, swelling from 4.82 million trips in 2004 as shown in Table 12.2-4.

TABLE 12.2-4 FUTURE TOTAL TRIP PRODUCTION BY TRIP PURPOSE

Unit: Person Trip per Day

Target Year	Trip Purpose				
	HOME	WORK	SCHOOL	OTHERS	TOAL
2004	2,240,692	1,204,926	471,665	898,174	4,815,457
2010	2,754,523	1,561,561	555,149	1,058,297	5,929,530
2015	3,087,894	1,751,447	631,203	1,176,492	6,647,036
2025	3,843,578	2,196,167	783,155	1,453,069	8,275,969

12.3 FORECASTING TRIP GENERATION AND ATTRACTION

(1) Modeling Trip Generation and Attraction

The objective of trip generation and attraction model is to forecast the number of trips that will start and arrive in each traffic zone within the Study Area. The linear regression models by trip purpose are adopted in the Study. The model parameters are calibrated as shown in Table 12.3-1.

Gi = ai*X1i + bi*X2i +

Aj = aj*X1j + bj*X2j +

Where, Gi: Trip Generation in zone i

Aj : Trip attraction in zone j

X1i, X2j: Attributes in zone i, j

ai, aj, bi, bj: Coefficient

TABLE 12.3-1 TRIP GENERATION AND ATTRACTION MODEL PARAMETERS

Model Type	Trip Purpose	Population 5 & Above	Worker at Office Base	Student at Enrolment Base	R-squared
Trip Generation	HOME	0.1018	1.0279	1.4670	0.9876
	WORK	0.5226	-	-	0.9447
	SCHOOL	0.2131	-	-	0.9402
	OTHERS	0.3102	0.1888	-	0.9477
Trip Attraction	HOME	1.0317	-	-	0.9718
	WORK	-	1.0165	-	0.9922
	SCHOOL	-	-	0.9476	0.9331
	OTHERS	0.2109	0.3341	-	0.8871

(2) Balancing Trip Generations and Attractions

It is necessary to achieve an exact balance between trip generations and attractions before performing the trip distribution process. This is because each generation must be paired with a corresponding attraction. As with most models, a higher confidence level is placed on generations since they are generated from household data. Employment data is much more difficult to collect and, hence, has a lower confidence level of accuracy. Consequently, using the totals of trip productions by purpose forecast when applying the Cross-Classification trip rate as shown in the above Table 12.2-4, trip generations and attractions are balanced.

(3) Future Zonal Framework

The future framework that is likely to ensure in 2025 compared with that in 2004 is shown in Figure 12.3-1. The data tables of future framework are available in Section 12.1 of Appendix 12.

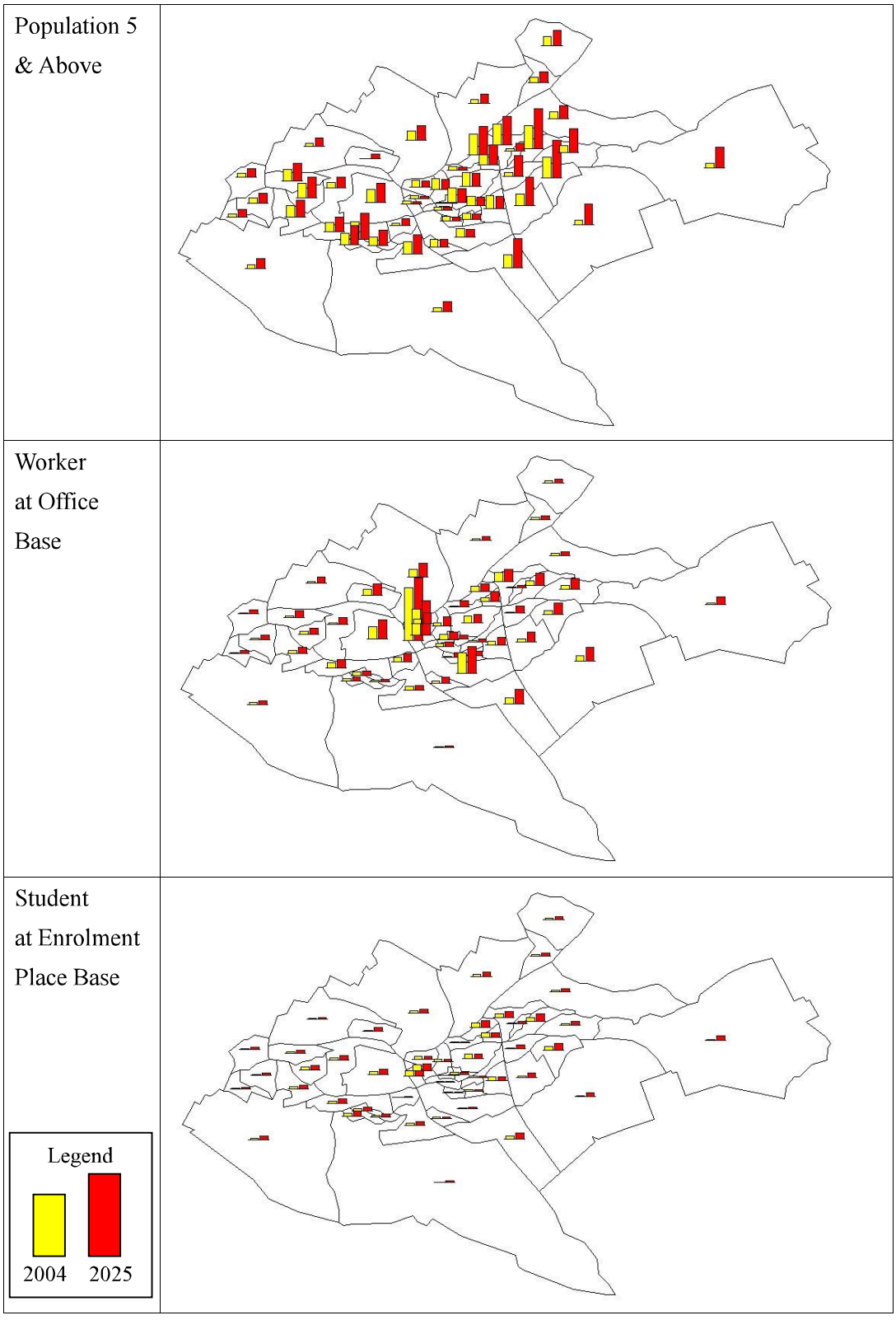

FIGURE 12.3-1 COMPARISON OF ZONAL FRAMEWORK IN 2004 AND 2025