**BASIC PRINCIPLES OF TRAFFIC DEMAND ANALYSIS AND THEIR EFFECT WHEN FORECASTING FUTURE TRAFFIC FLOWS**

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**MATRIC NO: 15/ENG03/003**



**SUBMITTED IN PARTIAL FULFILMENT**

**OF THE REQUIREMENT FOR THE AWARD OF THE**

**BACHELOR OF ENGINEEERING (B.ENG) DEGREE IN CIVIL ENGINEERING**

**TO**

**ENGR POPOOLA O.0.**

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 **NIGERIA**

**APRIL, 2020**

# Introduction to the Basic Principles of Traffic Demand Analysis

The prediction of highway demand requires a unit of measurement for travel behavior to be defined. This unit is termed a trip and involves movement from a single origin to a single destination. The parameters utilized to detail the nature and extent of a given trip are as follows:

* Purpose
* Time of departure and arrival
* Mode employed
* Distance of origin from destination
* Route travelled.

## Demand modelling

Demand modelling requires that all parameters determining the level of activity within a highway network must first be identified and then quantified in order that the results output from the model has an acceptable level of accuracy, there are an enormous number of decisions relating to that trip, all of which must be considered and acted on simultaneously within the model. These can be classified as:

 **Temporal decisions** – once the decision has been made to make the journey, it still remains to be decided when to travel

 **Decisions on chosen journey destination** – a specific destination must be selected for the trip, e.g. a place of work, a shopping district or a school

 **Modal decisions** – relate to what mode of transport the traveler intends to use, be it car, bus, train or slower modes such as cycling/walking

 **Spatial decisions** – focus on the actual physical route taken from origin to final destination. The choice between different potential routes is made on the basis of which has the shorter travel time.

## Land use models

The demand for movement or trip making is directly connected to the activities undertaken by people. These activities are reflected in both the distribution and type of land uses within a given area. By utilising relationships between present day land uses and consequent movements in a given area, estimates of future movements given on land-use projections can be derived

A land use model estimates the future development for each of the zones within a study area, with estimates relating not only to predictions regarding the different land uses but also to those socio-economic variables that form the basic data for trip generation, the first of the four-stage sequential models. Input by experienced land-use planners is essential to the success of this phase. The end product of the land-use forecasting process usually takes the form of a land use plan where land-use estimates stretching towards some agreed time horizon, usually between 5 and 25 years, are agreed.

**Trip generation**

Trip generation models provide a measure of the rate at which trips both in and out of the zone in question are made. They predict the total number of trips produced by and attracted to its zone. Centers of residential development, where people live, generally produce trips. The denser the development and the greater the average household income is within a given zone; the more trips will be produced by it. Centers of economic activity, where people work, are the end point of these trips. The more office, factory and shopping space existing within the zone, the more journeys will terminate within it. These trips are 2-way excursions, with the return journey made at some later stage during the day.

The relationships between trips generated and the relevant variables are expressed as mathematical equations, generally in a linear form. For example, the model could take the following form:

 T*ij* = a + a0 1Z1 *j* + a 2Z2 *j* +L+ a *n*Z*nj* eqn (1)

where

T*ij* = number of vehicle trips per time period for trip type *i* (work, non-work) made by household *j*

Z = characteristic value *n* for household *j*, based on factors such as the household income level and number of cars available within it

a = regression coefficient estimated from travel survey data relating to *n*

**Trip distribution**

The previous model determined the number of trips produced by and attracted to each zone within the study area under scrutiny. For the trips produced by the zone in question, the trip distribution model determines the individual zones where each of these will end. For the trips ending within the zone under examination, the individual zone within which each trip originated is determined. The model thus predicts zone-to-zone trip interchanges. The process connects two known sets of trip ends but does not specify the precise route of the trip or the mode of travel used.

There are several types of trip distribution models, including the gravity model and the Furness method.

**The gravity model**

The gravity model is the most popular of all the trip distribution models. It allows the effect of differing physical planning strategies, travel costs and transportation systems to be taken into account. Within it, existing data is analyses in order to obtain a relationship between trip volumes and the generation and attraction of trips along with impedance factors such as the cost of travel.

 *A PFj i ij*

 *Tij* = (1.1)

 Â (*PFi ij)*

*j*

where

*Tij* = trips from zone i to zone j

*Aj* = trip attractions in zone j

*Pi* = trip productions in zone i

*Fij* = impedance of travel from zone i to zone j

**The Furness method**

This again is a growth factor method, but in this instance the basic assumption is that in the future the pattern of trip making will remain substantially identical to those at present, with the trip volumes increasing in line with the growth of both the generating *and* attracting zones.

**Modal split**

Trips can be completed using different modes of travel. The proportion of trips undertaken by each of the different modes is termed modal split. The simplest form of modal split is between public transport and the private car. While modal split can be carried out at any stage in the transportation planning process, it is assumed here to occur between the trip distribution and assignment phases.

**Traffic assignment**

Traffic assignment constitutes the final step in the sequential approach to traffic forecasting. The output from this step in the process will be the assignment of precise quantities of traffic flow to specific routes within each of the zones.

Assignment requires the construction of a mathematical relationship linking travel time to traffic flow along the route in question. The simplest approach involves the assumption of a linear relationship between travel time and speed on the assumption that free-flow conditions exist, i.e. the conditions a trip maker would experience if no other vehicles were present to hinder travel speed.

# Conclusion

Travel demand models has a major influence on the policy of expanding road networks and program. Predicting flows along the links within a highway network provides vital information for the economic and environmental assessments required as part of the project appraisal process and allows the scale of each individual project within the network to be determined. Once the demand analysis and appraisal process have been completed, the detailed junction and link design can then be undertaken. It should be remembered, however, that the modelling process is a simplification of reality. Predictions arising from it are broad estimates rather than precise forecasts. The error range within which the model results are likely to fall should accompany any data supplied to the transport planners.

# Reference

Martin Rogers.2003. Highway engineering, *transport planning process*. Blackwell Science Ltd, Paris, France, pg. 15-34.