



# TEXAS SOUTHERN UNIVERSITY

Project Summary Report 4142-S

Project 0-4142: Forecasting Traffic Characteristics for Air Quality Analysis

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## PROJECT SUMMARY REPORT

### Summary Report on Forecasting Traffic Characteristics for Air Quality Analysis

A crucial part of using MOBILE is the input of reliable mobile source emission related travel indicators, such as the vehicle age distribution, mileage accumulation rates by vehicle type, vehicle miles traveled (VMT) & mix, compositions of traffic, average speeds, etc.

MOBILE includes default values for a wide range of conditions that affect emissions. These defaults are designed to represent “national average” input data values. However, variations in roadway

network characteristics between different areas are big enough to justify the use of locally developed travel indicators.

#### What We Did...

This research intended to develop techniques for estimating and forecasting critical mobile source emission related travel indicators. **Figure 1** illustrates three important traffic indicators that will affect emission factors. The techniques and models include forecasting vehicle age distribution through regression modeling;

adjusting mileage accumulation rates based on small sample survey; improving VMT related variables by connecting link volume with count data and link attributes.

Two model types for forecasting vehicle age distribution were developed and tested in El Paso and 8 HGAC (Houston-Galveston Area Council) counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller.

Surveys on vehicle mileage traveled were conducted in the areas of Houston and El Paso. Survey results were summarized and used for developing the algorithm to adjust vehicle mileage accumulation rate based on small sample survey.

Extensive efforts were made on collecting information on VMT & mix estimation. A survey through e-mail was conducted to ascertain what methodologies were being used by other states. As the new version of MOBILE (MOBILE6)

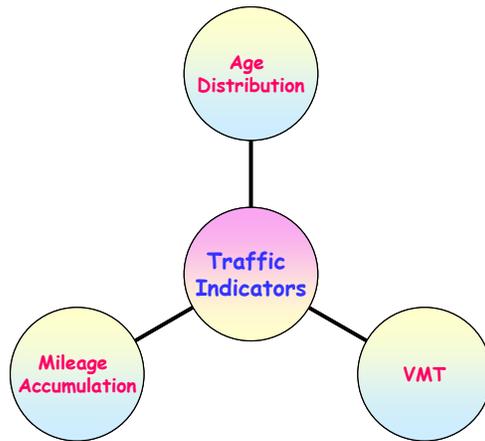


FIGURE 1 Three traffic indicators modeled in the research.



requires much more detailed information, the proposed improvements are not limited to the general VMT mix estimation as required in the project proposal.

The proposed improvements on estimation of VMT related variables were tested in Southwest Houston area and the results were compared with the default and other method.

### What We Found...

#### Development of models for forecasting vehicle age distribution

Two types of models were developed for the projection of vehicle age distribution. Model Type I (MT I) models the number of vehicles for particular vehicle type and age and then transfers results to vehicle age distribution. Model Type II (MT II) models the future age distribution directly.

The models can automatically select optimal inputs of socio-economic indices that are correlated to age distribution.

It is often impossible, in real cases, to collect enough predictable socioeconomic data. A suboptimal selection of independent variables allows less socioeconomic data as inputs to model. Based on the case studies in 8 HGAC counties and El Paso, three more usable and predictable socioeconomic indices were selected: *total population, total employment, and personal income*. Figure 2 presents the three emission factors by default age distributions and by forecasted local ones from models for different counties in 2001.

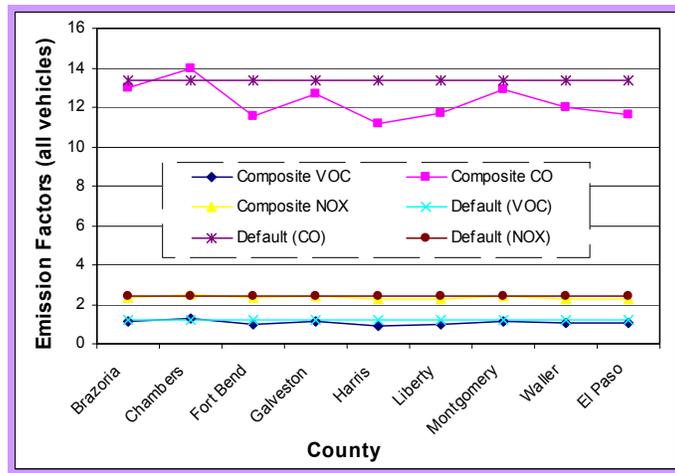


FIGURE 2 Comparison of emission factors by default and forecasted vehicle age distributions for 8 HGAC counties and El Paso in the year 2001.

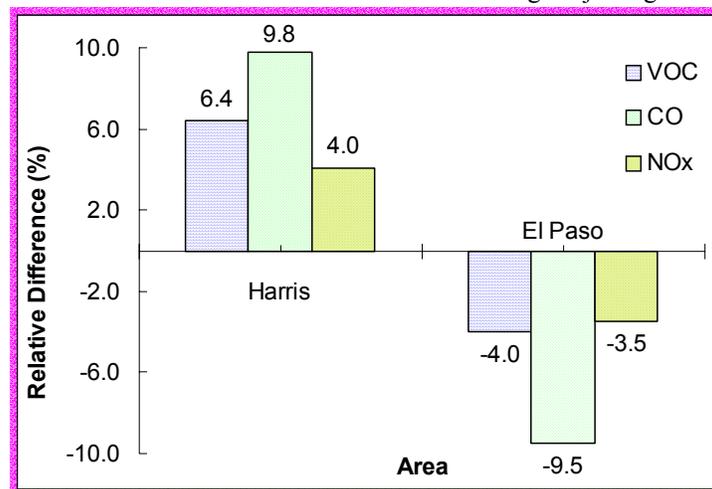
#### Adjusting Vehicle Mileage Accumulation Rates Based on Small Sample Survey

Due to the survey cost, it is very hard to conduct a large-scale full-sized survey on mileage accumulation rates for most of the local areas. Also, inspection and maintenance (I/M) data may not always be available. However, using the default values directly (which may differ from the local ones) can cause inaccurate estimates of emission factors.

A realistic approach to solving

this problem is to conduct a small sample survey in the concerned area and then adjust the MOBILE6 default values by incorporating the local information collected. Although they are transferable, vehicle types in the small sample survey may not necessarily be the same as those required by MOBILE6. Sample size can be determined based on the predetermined confidence levels and survey errors are eventually guaranteed.

In a case study in Houston and El Paso, four vehicle types were surveyed and the corresponding group setting was determined. The average adjusting factors for



Houston and El Paso are 1.34 and 0.58, respectively. Impacts to emission factors are shown in Figure 3. From Figure 3 we can see that the emission factors in Houston are much larger than in El Paso. These results make sense since people in Houston might travel more than the average U.S. cities; while in El Paso travel less.

### Improvement to VMT Estimation for Air Quality Analysis

Improved methodology for VMT estimation sets up relationships between link volume and the count data as well as link attributes.

The calibrated coefficients in the improved volume estimation algorithm can be obtained by a multivariate regression analysis using any standard routine.

Link volume should be disaggregated according to the hour of day so that hourly VMT can be obtained. The speed VMT can be estimated as well by applying the BPR curve.

To obtain the hourly VMT, the distribution of link-level volumes by hour of day should be prepared by using the user-provided distribution or default ones. The hourly link VMT can be obtained directly by multiplying the link distance with the hourly volume.

After the hourly distributions of VMT by speed are obtained for all kinds of facilities, it is easy to get the other VMT related variables required in MOBILE6.

Based on a case study in the Southwest Houston area, the final estimated local VMT related variables were input into MOBILE6 so that the impacts on emission estimations could be obtained. Figure 4 lists the

estimates errors for three emission factors (VOC, CO and NO<sub>x</sub>) based on different scenarios. Improved (I) means that the improved model

order to forecast vehicle age distribution. The computer software realizing the techniques will be improved with a user-friendly interface suitable for

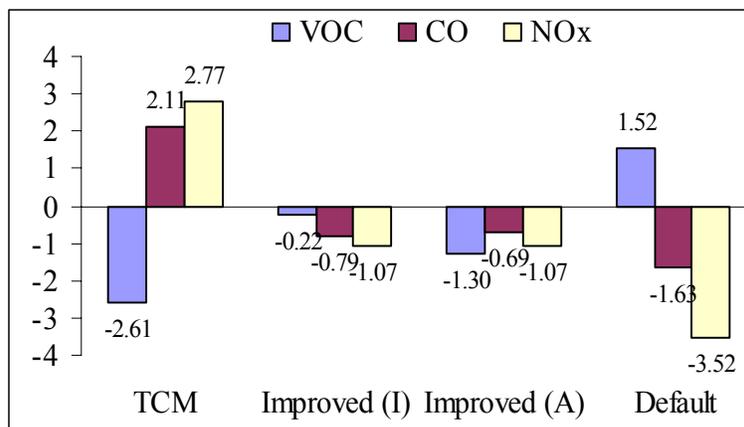


FIGURE 4 Relative errors (%) for estimates of emission factors based on different scenarios.

calibrated each facility type independently; while Improved (A) means that the calibrated model for freeway was used to links of all facility types. It is shown that the proposed improvements have better estimation on emission factors than both the nationwide default one and TCM estimation. The relative errors of the three emission factors for the improvements are smaller than both TCM and default values.

### The Researchers Recommend ...

The researchers recommend implementing the developed techniques and models in Texas. Suitable programs for practical use are necessary and the proposed models should be further improved based on more practical information. Suggested default values of three travel indicators for different Texas cities and for the entire state of Texas should be provided.

Information for different Texas counties should be collected in

different types of users. The software should produce rich output information. In addition, state and county defaults should be generated.

For mileage accumulation rate, several prototype cities in Texas can be selected to represent different city types. A workable spreadsheet based on the corresponding algorithm will be developed. Default values of mileage accumulation rates for the analyzed cities will be estimated and extended to all Texas cities and the entire state of Texas.

As for VMT and related variables, several prototype cities in Texas representing different city categories should be selected first. The computer software for VMT estimation is going to be developed with a user-friendly interface that is suitable for different types of users.



## For More Details . . .

This research is documented in

Related Reports: Report 4142-9, *Research Report on Forecasting Traffic Characteristics for Air Quality Analysis*

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## TxDOT Implementation Status August 2002

The products resulting from this research are techniques and models for forecasting three emission related travel indicators: vehicle age distribution, mileage accumulation rates and Vehicle Miles Traveled (VMT) related variables. The developed techniques and models have been included in the “*Research Report TxDOT 4142-9*” and the “*Guidebook on Forecasting Traffic Characteristics for Air Quality Analysis*”. The researchers recommend implementing the proposed techniques and models in more Texas counties and cities. By this kind of implementation process, the user-friendly software and default values of the three variables for whole Texas State and all Texas Cities/Counties can be obtained.

For more information, please contact Charlie Hall, TxDOT Transportation Planning and Programming Division, [CDHALL@dot.state.tx.us](mailto:CDHALL@dot.state.tx.us), (512) 486-5120.

## Disclaimer

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