Vehicle Classification System: FHWA Perspective

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Abstract: *Issues related to vehicle classification in light of the FHWA Traffic Monitoring Guide (TMG) revision will be discussed. The discussion will look at the expressed needs of the data users and the associated impacts on data collection programs including the relationship of vehicle classification data collection to traffic volume and vehicle weight data collection efforts. Background information will be provided discussing the evolution of the vehicle classification data collection program reflected in the draft TMG from the perspectives of both the intensity of the data collection effort as well as the identification of the set of vehicle types that most effectively responds to data user needs. The overarching need to establish consistent procedures that enhance data quality with be emphasized.*

Introduction

Vehicle classification data are useful in:

- pavement design and pavement management;
- scheduling resurfacing, reconditioning, and reconstructing of highways based on projected pavement life remaining;
- predicting commodity flows and freight movements;
- providing design input relative to current and predicted capacity of highways;
- developing weight enforcement strategies;
- accident record analysis;
- environmental impact analysis, including air quality studies; and
- analysis of alternative highway regulatory and investment policies.

Although the uses identified above are taken from a recent research proposal, the verbiage is that used in 1985 to introduce the vehicle classification discussion in the original Traffic Monitoring Guide (TMG). While the uses of the data have remained constant over time, the data users expectations for geographic and temporal specificity have grown enormously.

Some History

The 13 FHWA vehicle classes have been in use for about 15 years. The process that led to their development was based on a review of classifications then in use, anticipated data types that would be needed to address then emerging issues, current data needs expressed by major data users, and the recommendations of the States. It is worth noting that the ability to collect the data automatically did not influence the development of the classification scheme.

The inclusion of the 13 classes as part of the original TMG legitimized their use and led to their adoption in various national efforts such as the HPMS and the Long-Term Pavement Performance (LTPP) element of the Strategic Highway Research Program as well as being adopted for use by various States. Paralleling this adoption of the 13-classes was the emergence of data collection technologies that attempt to automate the monitoring process.

While the inclusion of the 13-class scheme as part of the TMG sought to assure that some data would be available for each of the vehicle types on each of the functional classes of highway, the specific statistical objective for vehicle classification within the original TMG was to assure that at the end of a sampling cycle (three years) statewide estimates of the percentage of 3S2's (combination trucks with a 3-axle tractor and a 2-axle semitrailer) in the traffic stream would be available with an approximate reliability of plus or minus 10 per cent of the estimate with 95 percent confidence.

Although unstated, it was assumed that the vehicle classification data collected in conformance with the TMG would assure a readily available source of vehicle classification data for national purposes and would avoid the future need to conduct a Vehicle Classification Case Study as had been done in 1980 to support the HPMS. The Case Study documentation and its Final Report record that it was intended that the percent of trucks reported on HPMS sample sections would be specific to each section rather than a value typifying a system average and that the more finely stratified vehicle types monitored through the Case Study would be used to augment the sample section values in support of national studies.

In 1988 the TMG vehicle classes were accepted as the format for vehicle class data for the LTPP. The LTPP effort focused greater attention on the vehicle classification programs of the various States by creating a very high level of expectations for the quality of the vehicle class data that could be made available on a regular or, if needed, continuous basis to support the site-specific LTPP needs. The high expectations of the LTPP have also been exhibited by data users who are addressing safety, environmental and economic issues. It was with a clear recognition of the expectations of the data users that FHWA began the revision of the TMG.

The New TMG

The new TMG presents an approach to traffic data collection that seeks to provide data that are more descriptive of specific locations and that also provide greater information on the temporal variation in activity by vehicle class. The approach taken in the new TMG challenges the state of the practice including the recommendations of previous editions of the TMG. While the final form of the new edition will depend on the comments of the various States and major data users, it is clear that we will need to address:

- The degree to which classification activities will supplant volume counting activities, and

- How the prudent use of a more limited set of generic vehicle types add to the information we can garner from vehicle classification databases.

Classification vs Volume Counts

In order to meet the need for a significant increase in vehicle classification data and recognizing that program resources are limited, the new TMG proposes that a significant portion (30 percent) of the current volume counting program be transitioned to a vehicle classification program. As with the volume counting program, the classification program would consist of a coverage element of short duration counts supported by a continuous count program:

> The short duration classification counting program seeks to ensure that highway agencies have valid truck volume information for all highways under their jurisdiction. A specific emphasis of this program is to collect data on HPMS sample segments, since these segments serve a large number of users and uses. At the same time, collecting data on the HPMS sample provides a good start on a geographically diverse set of roadway locations. The specific data collection recommendations are:
>
> - Classification counts should be performed at existing HPMS sample sections
> - Each agency should perform a minimum of one vehicle classification count on each road each year.
> - For roads that change character and/or sustain significant truck volume changes over their length, one count should be taken on each segment of that roadway each year.
>
> The continuous classification count program has a major goal of supporting the development of adjustment factors needed to estimate annual average daily truck volumes from the short duration classification counts. To accomplish this goal it is necessary to measure day-of-week and seasonal variations in truck traffic for each of the truck volume patterns found in a State. The continuous classification count program is expected to be roughly the same size as the traditional continuous volume count program. The new TMG provides direction on factoring procedures that could be used by the highway agency.

Fewer Classes

A key recommendation supporting the development of truck factors is to use only three or four generic categories of vehicles. The suggested classes for factoring are:

- passenger vehicles
- single-unit trucks
- single trailer combination trucks, and

" multi-trailer combination trucks.

The use of an aggregated classification scheme for factoring short duration classification counts is recommended because in some States, volumes in many of the 13-FHWA vehicle categories are very low. When volumes within a vehicle class are low, the adjustment factors computed for those vehicle categories are imprecise. Aggregating vehicle classes allows the factoring process to keep the majority of truck volumes high enough to provide stability to the calculated factors.

By acknowledging the utility of a set of generic vehicle types, FHWA is not saying that the needs addressed by the 13 classes have been met. Rather we are saying that the strategic use of the generic types supports the operation of a more effective and responsive vehicle classification program. Basic to the use of generic vehicle types, is the need to provide a crosswalk between the generic types and the 13 classes. In February we asked our field offices to provide us with the following information on the use of length-based generic types in their State:

" Where does each of the 13 classes fit within the generic types

" What testing was done to verify that the generic classification scheme works,

" Under what situations would the generic classes be used, and

" What methods, if any, are used to disaggregate the generic types into the 13 classes.

Effective implementation of the TMG recommendations will require dialogue among traffic data collection professionals on standards of practice that address these types of questions.

Data Needs and Program Opportunities

The Interim

While use of generic vehicle types will assist in the development of factors to apply to short term classification data collection, the 13 vehicle types will remain commonly accepted descriptors of the vehicle stream. They are key elements of the software and hardware we use to conduct our business. Furthermore, many of the users of our data have developed long term analyses with the assumption that the classification types would continue to be reported. At the same time, we need to assess whether the reporting of travel data at the 13-class level is necessary or appropriate in all situations.

For example, the reporting of the proportion of a State s VMT attributable to each vehicle class on each of the 12 highway functional classes has been a requirement of the annual HPMS submittal process since 1985 (Figure 1). The reporting was established in order to have an on-going comprehensive data source that would meet the programmatic needs that had been addressed through the 1980 Vehicle Classification Case Study. While most State s report this data, individuals familiar with the data collection process have always expressed concerns over the resources needed to support its reporting. For the data user, the apparent ease with which the

data are reported has often insulated them from giving careful consideration of its fitness for application to their specific issues.

In addition to these system level estimates of the composition of the traffic streams reported through the form in Figure 1, the HPMS also reports the percent of single and combination trucks as part of the data for each sampled section. As Figure 2 shows, when the sample data is expanded it represents a significant proportion of the vehicle activity that is also reported in Figure 1.

An annual product of the Office of Highway Policy Information is Table VM-1 Annual Distance Traveled and Related Data by Highway Category and Vehicle Type . Development of Table VM-1 depends on the availability of current vehicle classification data. Figure 3 shows how the vehicle and highway classes are grouped for reporting in Table VM-1.

FHWA s reorganization has provided each of its Business Units with an opportunity to review their program s data and other resource needs. In its review, the Office of Highway Policy Information identified a continuing need for the truck percentage information reported as part of the HPMS sample as well as an ongoing need to support the production of Table VM-1. The review found that the detailed vehicle classification reporting portrayed in Figure 1 would not be necessary to develop Table VM-1 if the data types identified in Figure 4 were available to augment the HPMS sample data. We are currently assessing the ramifications of reduced reporting.

Longer Term Objectives

FHWA has been providing monthly estimates of the Nation s highway travel for the last 60 years. A cursory review of current State programs suggests that there are over 1900 continuous automatic vehicle classification (CAVC) sites nationally. We hope to leverage these CAVC efforts and be able to augment the monthly reporting of total travel with monthly reporting of truck travel. This capability would also directly support the development of Table VM-1 and remove the need for additional system level reporting of vehicle activity through the HPMS.

The reporting of CAVC data will also provide the detailed information necessary to support the development of the vehicle classification factors recommended by the new TMG.

We also are assessing the feasibility of using the CAVC data in conjunction with WIM data to develop periodic estimates of vehicle loadings and truck volumes on each link of the National Highway System. Such estimates would be valuable in support of pavement management and design, safety analysis, statewide and metropolitan planning, and truck weight enforcement.

Conclusions

1. Application of the new TMG will lead to a classification counting program that will provide improved estimates of truck volumes,

2. The HPMS will continue to require estimates of truck percentages on every sample section that are based on section specific measurements rather than system averages,

3. Any use of generic classes, will require rigorous documentation of methods used to identify the generic types,

4. There is a continuing need to have vehicle classification data available with the 13-class detail, and

5. The expanding use of CAVC offers major opportunities to provide information that is vital to highway management and operations.

Figure 1 - Areawide data as reported to the Highway Performance Monitoring System

TRAVEL ACTIVITY BY VEHICLE TYPE

PERCENT OF TRAVEL

FUNCTIONAL SYSTEM	MOTOR-CYCLES [OPTIONAL]	PASSENGER CARS [2 AXLE, 4 TIRE]	LIGHT TRUCKS [OTHER 2 AXLE, 4 TIRE]	BUSES	SINGLE-UNIT TRUCKS			SINGLE-TRAILER TRUCKS			MULTI-TRAILER TRUCKS			TOTAL
					2 AXLE 6 TIRE	3 AXLE	4 AXLE OR MORE	4 AXLE OR LESS	5 AXLE	6 AXLE OR MORE	5 AXLE OR LESS	6 AXLE	7 AXLE OR MORE	
RURAL														
INTERSTATE	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
OTHER PRINCIPAL ARTERIAL	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
MINOR ARTERIAL	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
MAJOR COLLECTOR	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
MINOR COLLECTOR	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
LOCAL	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
URBAN														
INTERSTATE	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
OTHER EXPRESSWAYS & EXPRESSWAYS	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
OTHER PRINCIPAL ARTERIAL	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
MINOR ARTERIAL	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
COLLECTOR	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	
LOCAL	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	

Figure 2 - Data Available from HPMS Samples

TRAVEL ACTIVITY BY VEHICLE TYPE

PERCENT OF TRAVEL

FUNCTIONAL SYSTEM	MOTOR-CYCLES [OP-TIONAL]	PAS-SENGER CARS [2 AXLE, 4 TIRE]	LIGHT TRUCKS [OTHER 2 AXLE, 4 TIRE]	BUSES	SINGLE-UNIT TRUCKS			SINGLE-TRAILER TRUCKS			MULTI-TRAILER TRUCKS			TOTAL
					2 AXLE 6 TIRE	3 AXLE	4 AXLE OR MORE	4 AXLE OR LESS	5 AXLE	6 AXLE OR MORE	5 AXLE OR LESS	6 AXLE	7 AXLE OR MORE	
RURAL	**Residual Vehicles**			**Single Unit Truck or Vehicle**				**Combination Truck or Vehicle**						
INTERSTATE	**Data**			**Data**				**Data**						
OTHER PRINCIPAL ARTERIAL	**Data**			**Data**				**Data**						
MINOR ARTERIAL	**Data**			**Data**				**Data**						
MAJOR COLLECTOR	**Data**			**Data**				**Data**						
MINOR COLLECTOR														
LOCAL														
URBAN														
INTERSTATE	**Data**			**Data**				**Data**						
OTHER EXPRESSWAYS & EXPRESSWAYS	**Data**			**Data**				**Data**						
OTHER PRINCIPAL ARTERIAL	**Data**			**Data**				**Data**						
MINOR ARTERIAL	**Data**			**Data**				**Data**						
COLLECTOR	**Data**			**Data**				**Data**						
LOCAL														

Figure 3 - The Vehicle and Highway Groups Used in Table VM -1 Annual Distance Traveled and Related Data by Highway Category and Vehicle Type

TRAVEL ACTIVITY BY VEHICLE TYPE

PERCENT OF TRAVEL

FUNCTIONAL SYSTEM	MOTOR-CYCLES [OP-TIONAL]	PAS-SENGER CARS [2 AXLE, 4 TIRE]	LIGHT TRUCKS [OTHER 2 AXLE, 4 TIRE]	BUSES	SINGLE-UNIT TRUCKS			SINGLE-TRAILER TRUCKS			MULTI-TRAILER TRUCKS			TOTAL
					2 AXLE 6 TIRE	3 AXLE	4 AXLE OR MORE	4 AXLE OR LESS	5 AXLE	6 AXLE OR MORE	5 AXLE OR LESS	6 AXLE	7 AXLE OR MORE	
RURAL					**SU 2A6T and More**			**Combination Trucks**						
INTERSTATE	Data	Data	Data	Data	Data			Data						
OTHER PRINCIPAL ARTERIAL	Data	Data	Data	Data	Data			Data						
MINOR ARTERIAL														
MAJOR COLLECTOR	Data	Data	Data	Data	Data			Data						
MINOR COLLECTOR														
LOCAL														
URBAN														
INTERSTATE	Data	Data	Data	Data	Data			Data						
OTHER EXPRESSWAYS & EXPRESSWAYS	Data	Data	Data	Data	Data			Data						
OTHER PRINCIPAL ARTERIAL														
MINOR ARTERIAL														
COLLECTOR														
LOCAL														

Figure 4 - Data Need Not Met by HPMS Sample Alone

TRAVEL ACTIVITY BY VEHICLE TYPE

PERCENT OF TRAVEL

FUNCTIONAL SYSTEM	MOTOR-CYCLES [OPTIONAL]	PASSENGER CARS [2 AXLE, 4 TIRE]	LIGHT TRUCKS [OTHER 2 AXLE, 4 TIRE]	BUSES	SINGLE-UNIT TRUCKS			SINGLE-TRAILER TRUCKS			MULTI-TRAILER TRUCKS			TOTAL
					2 AXLE 6 TIRE	3 AXLE	4 AXLE OR MORE	4 AXLE OR LESS	5 AXLE	6 AXLE OR MORE	5 AXLE OR LESS	6 AXLE	7 AXLE OR MORE	
RURAL					**SU 2A6T and More**			**Combination Trucks**						
INTERSTATE	**Data**		**Data**	**Data**										
OTHER PRINCIPAL ARTERIAL	**Data**		**Data**	**Data**										
MINOR ARTERIAL														
MAJOR COLLECTOR	**Data**		**Data**	**Data**										
MINOR COLLECTOR					**Data**			**Data**						
LOCAL														
URBAN														
INTERSTATE	**Data**		**Data**	**Data**										
OTHER EXPRESSWAYS & EXPRESSWAYS	**Data**		**Data**	**Data**										
OTHER PRINCIPAL ARTERIAL														
MINOR ARTERIAL														
COLLECTOR														
LOCAL					**Data**			**Data**						