

**American Association of State Highway and Transportation Officials  
Special Committee on Research and Innovation**

**FY2021 NCHRP PROBLEM STATEMENT**

**1. Problem Title**

Assignment of short-duration traffic volume counts to adjustment factor groups.

**2. Background**

Annual average daily traffic (AADT) is one of the most widely used data inputs in transportation engineering. Transportation agencies use AADT to meet data reporting requirements, allocate resources, better inform decision-making, and support various agency functions. State Departments of Transportation (DOTs) are required to report AADT every year to the Highway Performance Monitoring System (HPMS) for the full extent of mainlines, samples, and ramps on all Federal-aid facilities.<sup>1</sup> In addition, the 2016 Highway Safety Improvement Program (HSIP) Final Rule requires States to have access to AADT for all paved public roads by year 2026. Transportation agencies estimate AADT using variations of a traditional method that was first introduced by Drusch in 1966<sup>2</sup> and is recommended by FHWA's TMG.<sup>1</sup> The traditional approach combines traffic data from permanent and portable traffic counting equipment. Continuous count sites (CCSs) collect traffic data 24 hours a day, seven days a week for all days of the year or extended periods of time.<sup>1</sup> Because of the high installation, operation, and maintenance cost of CCSs, agencies tend to install them at select locations and conduct short-duration counts at locations that have not been counted. The goal is to adjust and expand the short-duration counts to obtain accurate AADT estimates. The main steps of the traditional method are:

- Gather traffic volume data from CCSs and calculate adjustment factors (e.g., seasonal, monthly, day-of-week, axle, etc.) for each CCS. This step is widely known as the “factoring” step.
- Establish monthly pattern groups that are homogenous. Create factor groups based on one or multiple grouping approaches. This step is widely known as the “grouping” step.
- Compute adjustment factors (e.g., hour-of-day factor, month of year factor) for each group. The adjustment factors are computed from the factors of the CCSs contained in each group.
- Assign short-duration counts to the previously determined factor groups. Agencies typically base the assignment task on the location, functional class or other characteristics of the roadway section where a count was taken. This step is widely known as the “assignment” step.
- Multiply the average daily traffic (ADT) of a short-duration count with the appropriate group adjustment factor(s) to generate an AADT estimate.

One caveat of the traditional AADT estimation process is that the accuracy of the predictions is subject to errors inherent within each step of the process. Prior research has shown that the “assignment” step is the most critical element in the AADT estimation process.<sup>3</sup> Potential ineffective allocation of short-duration counts to factor groups may triple the prediction error<sup>4</sup>, yet, a small number of studies have dealt with the improvement of the assignment procedure.<sup>5</sup> Because of limited research and knowledge on this topic, current guidelines are not prescriptive on how short-duration counts should be assigned to factor groups. Previous studies have concluded that statistical methods are necessary to

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<sup>1</sup> Federal Highway Administration, *Traffic Monitoring Guide*, Washington D.C., October, 2016.

<sup>2</sup> Drusch, R. Estimating Annual Average Daily Traffic from Short-term Traffic Counts. *Highway Research Record*, No. 118, 1966, pp. 85-95.

<sup>3</sup> Sharma S. C., B. M. Gulati, and S. N. Rizak. Statewide Traffic Volume Studies and Precision of AADT Estimates. *Journal of Transportation Engineering*, 122 (6), 1996, pp. 430-439.

<sup>4</sup> Davis, G. A. Estimation Theory Approaches to Monitoring and Updating Average Annual Daily Traffic. Office of Research Administration, Minnesota Department of Transportation, St. Paul, 1996.

<sup>5</sup> Aunet, B. Wisconsin's Approach to Variation in Traffic Data. North American Travel Monitoring Exhibition and Conference (NATMEC), Wisconsin Department of Transportation, National Transportation Library, 2000.

support the assignment step, which is subject to human errors stemming from engineering judgment.<sup>6,7,8</sup> This research will fill this gap by determining the most effective assignment methods that agencies can use to improve the accuracy of AADT estimates derived from short-term counts. The problem statement directly relates to the scope, objectives, and seven core data principles (valuable, available, reliable, authorized, clear, efficient, accountable) of the AASHTO committee *Data Management and Analytics*.

### 3. Literature Search Summary

The literature reveals a limited number of studies that have concentrated on the assignment process.<sup>9,10</sup> <sup>11</sup> Though some of these methods have produced promising results, the majority of past studies are limited in scope and objectives; examine, validate, and compare a small number of methods; focus on small regions and transportation networks that have specific characteristics; use limited data from a small number of carefully selected CCSs; and consider short study periods. As a result, it is difficult to generalize past research findings and results and draw safe conclusions about the most effective count assignment methods. An assignment method that has proven to be effective in one region or state may not necessarily be effective in a different part of the country that exhibits different traffic, roadway, demographic, socioeconomic, and/or weather characteristics. Because of these limitations, there is limited guidance on how short-duration counts should be assigned to factor groups. To fill this gap, there is a need to conduct a comprehensive and in-depth study that will have wider scope and validate the performance of several assignment methods for different transportation networks nationwide. The need for this research study is described in a recent TRB Circular<sup>12</sup>.

### 4. Research Objective

The objective of this project is to determine the most effective methods of assigning traffic volume counts to adjustment factor groups. The project should be conducted in two Phases:

#### **Phase I – Research:**

- **Task 1.** Review the current state of practice and state of the art and identify candidate assignment methods for further examination.
- **Task 2.** Select up to five states to apply the assignment methods identified in Task 1.
- **Task 3.** Gather and process data needed to apply the assignment methods identified in Task 1.
- **Task 4.** Apply the assignment methods selected in Task 1 and validate their performance.
- **Task 5.** Develop project deliverables including a Phase II Work Plan.

#### **Phase II – Implementation:**

- **Task 6.** Conduct at least five pilot studies with three state and two local public agencies to apply the most appropriate method(s) at each agency.
- **Task 7.** Develop Phase II project deliverables including a Final Guidebook that will provide separately for each assignment method all the necessary information and elements (e.g., pros, cons, data inputs, methodological considerations, assumptions, anticipated accuracy, software requirements, implementation time and costs) to help transportation agencies select and implement the most appropriate assignment method(s).

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<sup>6</sup> Jin, L., C. Xu, and J. D. Fricker. Comparison of Annual Average Daily Traffic Estimates: Traditional Factor, Statistical, Artificial Neural Network, and Fuzzy Basis Neural Network Approach. Transportation Research Board 87th Annual Meeting, TRB, Washington, D.C., 2008.

<sup>7</sup> Zhao, F., M. T. Li, and L. F. Chow. Alternatives for Estimating Seasonal Factors on Rural and Urban Roads in Florida. Final Report. Research Center, Florida International University, Florida Department of Transportation, 2004.

<sup>8</sup> Ritchie, S., and M. Hallenbeck. Evaluation of a Statewide Highway Data Collection Program. Transportation Research Record: Journal of the Transportation Research Board, No. 1090, Washington, D.C., 1986, pp. 27-35.

<sup>9</sup> Sharma, S. C., and R. R. Allipuram. Duration and Frequency of Seasonal Traffic Counts. *Journal of Transportation Engineering*, 119 (3), 1993, pp. 345-359.

<sup>10</sup> Davis, G. A., and Y. Guan. Bayesian Assignment of Coverage Count Locations to Factor Groups and Estimation of Mean Daily Traffic. *Transportation Research Record: Journal of the Transportation Research Board*, No. 1542, Washington, D.C., 1996, pp. 30-37.

<sup>11</sup> FHWA, Pooled Fund Study TPF-5(292), Available at: [https://www.fhwa.dot.gov/policyinformation/travel\\_monitoring/pubs/aadt/](https://www.fhwa.dot.gov/policyinformation/travel_monitoring/pubs/aadt/)

<sup>12</sup> Advancing Highway Traffic Monitoring Through Strategic Research, Transportation Research Circular, No. E-C227, December 2017.

## **5. Urgency and Potential Benefits**

The majority of the transportation agencies will benefit from this research. The most important benefit is an anticipated improvement in the accuracy of AADT estimates derived from counts. The improved estimates will increase the reliability of the results obtained from various analyses where AADT is used as data input. Further, there is an expected improvement in the accuracy of reported statistics and other traffic parameters that are derived from AADT such as Vehicle Miles Traveled (VMT). Better VMT and AADT estimates will enhance the allocation of funds and better inform decision-making in several functions and phases of the project development process. In addition, the project deliverables are expected to decrease potential confusion and uncertainty related to the assignment of counts to factor groups, and thereby assist transportation agencies nationwide in applying consistent and effective assignment methodologies. If the proposed work is not performed, transportation agencies will not realize the aforementioned benefits and will continue to assign counts to factor groups largely based on engineering judgment and arbitrarily chosen criteria that may have not been validated. The end result will be decreased accuracy of AADT estimates due to the inherent error stemming from questionable and not well-researched assignment procedures and practices.

## **6. Implementation Considerations and Supporters**

Traffic monitoring programs and centers of federal, state, and local transportation agencies will be particularly interested in this research. Transportation agencies could implement the assignment methods to be included in the Guidebook produced in Phase II of this project. Section 4 (Research Objective) includes additional information related to the implementation phase of the project. The AASHTO Committee *Data Management and Analytics* might be interested in the research results.

## **7. Recommended Research Funding and Research Period**

Estimated budget for Phase I and Phase II: \$350,000 and \$250,000 respectively (\$600K in total).  
Expected research duration for Phase I and Phase II: 24 months and 12 months respectively.

## **8. Problem Statement Author(s)**

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## **9. Others Supporting the Problem Statement**

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