

Executive Summary

A. Introduction

Highway traffic monitoring and collection of traffic data by the states in the U.S. is mandated by the Federal Code 23 CFR 420.105(b)¹ as part of the U.S. Department of Transportation (U.S. DOT) Federal Highway Administration's (FHWA) responsibility to the Congress of the United States and the general public. The State Departments of Transportation (DOTs), Metropolitan Planning Organizations (MPOs) and local transportation agencies have been conducting traffic monitoring activities in conjunction with the Federal Highway Administration's (FHWA) Traffic Monitoring Guide for over 30 years. Given the fact that each state DOT, MPO, or local transportation departments is organized differently with unique budget and organizational structures, agencies have adopted a wide range of practices for collecting and processing traffic data. Additionally, emerging technologies and methodologies posed changes in how these traffic counting functions are performed, and have led some agencies to considering or moving toward contracting out various parts of their counting program (outsourcing) while others have continued to perform their activities using their own internal staff (insourcing).

The research aimed to gain insight into the rationale behind agencies' decision-making processes by collecting data from approximately 80 agencies through a web-based assessment with 63 questions and conducting interviews with approximately 30 agencies throughout the U.S. The research process involved assessment of state DOTs, MPOs, and local transportation agencies' resourcing practices for all aspects associated with traffic data collection activities under the following three categories:

- Category 1 - Permanent Sensor and/or Equipment Installations
- Category 2 - Portable and Permanent Counts
- Category 3 - Other (Non-traditional/Innovative) Contracting Methods

This research report summarizes the findings regarding agency practices for resourcing in several categories such as staffing, equipment, quality assurance/quality control, funding, and technology, along with some of the rationale behind the agencies' resourcing decisions, challenges the agencies have been facing, and methods they employed to overcome them. The report is intended to serve as a resource document to initiate dialogue between the state DOTs, MPOs, and local agencies to learn from each other's experiences. The report also provides a conceptual framework about the key considerations for developing decision-support mechanisms for the agencies to evaluate their current resourcing profiles.

B. Summary of Key Observations/Analyses (Web-based Assessment and Phone Interviews)

The following are the key observations/findings from the responses web-based assessment where responses were collected from 80 agencies, and phone interviews with 30 agencies, and the documentation that several agencies shared with the research team.

B.1. Staffing Levels and Resources - Full-time staff numbers of the agencies that outsource their traffic count activities are generally lower than the agencies that insource those activities. Reduced full-time staff levels and hiring freezes were significant contributing factors for agencies' outsourcing decisions for certain traffic data collection activities. The majority of the interviewed agencies indicated that staffing levels are a significant factor in their decision-making with regard to those activities, especially when they have to justify the funding requests for the data collection contracts versus full- or part-time staff. The flexibility of outsourcing appeared to be favored by many agencies, because it allowed them to suspend data collection during certain periods (seasonal, holidays, etc.) without presenting a challenge to allocate the staff to other activities and tasks. Agencies also believed that outsourcing allows them to change priorities with minimal impact to agency operations/staff.

¹U.S. Government Publishing Office, *Code of Federal Regulations*, Title 23, Chapter I, Subchapter E, §420.105 (a)-(c), 2015.

B.2. Resourcing Profiles - The resourcing practices were divided into four categories as fully insourced, mostly insourced, mostly outsourced, and fully outsourced. *Category 1 (Permanent Sensor and/or Equipment Installations)* - there was a near-even split among the state DOTs and MPOs for fully/mostly insourcing and fully/mostly outsourcing TMS activities. All local agencies reported either fully or mostly insourcing their TMS activities in Category 1. *Category 2 (Portable and Permanent Counts)* - there was a near-even split among MPOs and local agencies for fully/mostly insourcing and fully/mostly outsourcing TMS activities. The state DOTs tended toward fully or mostly insourcing their Category 2 TMS activities. *Category 3 (Other Contracting Methods)* - there was an even split among local agencies for fully/mostly insourcing and fully/mostly outsourcing TMS activities. The state DOTs and MPOs tend to fully or mostly insourcing their Category 3 TMS activities.

B.3. Documentation of Quality Assurance and Quality Control (QA/QC) Process - According to the collected data, 87.5 percent of the state DOTs have a documented QA/QC process, regardless of their agency's resourcing practice. The same distribution percentage is reduced to 53.3 for the MPOs and 28.5 for the local agencies. The term "documented" was defined as "routinely followed procedures that are reviewed and updated periodically." Interviewed agencies also indicated that having documented QA/QC procedures reduces the impact that staff changes can have on continuity and helps to ensure milestones are met and that all agency staff members are following the same checks. Based on the collected 23 responses, 60.9 percent of the agencies indicated that they have a written policy for their QA/QC checks of the outsourced data collection activities and data, and 34.8 percent indicated that they do not. In addition, 57.1 percent of the agencies indicated that they do not have a policy to inspect consultants' equipment, installation, and data processing facilities/equipment on the site or in the field.

B.4. Documentation of Decision-making Process - Although they reported having a long history with their current in/outsourcing practices, the majority of the agencies, regardless of type, had no formal or documented decision making processes. Out of the responding state DOT and MPOs, only 34.2 percent and 31.0 percent had a documented decision-making process, respectively. None of the responding local agencies had a documented decision making process for TMS activities. When the portable and permanent count activities are combined, 42.9 percent of the outsourcing and 23.0 percent of the insourcing agencies indicated that they have a documented process. Regardless of type (state DOT, MPO, or local), agencies have less documentation for their decision-making processes when they insource or outsource their equipment and CCS installations. The data also shows that agencies have less documentation for their decision-making process when they chose to insource both their count and equipment installation activities.

B.5. Decision-makers for Agencies' In/Outsourcing Practices - When all three categories of TMS activities are combined, the agencies identified the "TMS Program Director/Manager, Team Leader" as the predominant group of decision-makers by 46.5 percent, followed by "Agency, Department, or Division Director/Manager" group by 34.7 percent, and "Team of Agency Staff" by 18.8 percent.

B.6. Annual Budget Allocations for TMS Activities - The state DOTs have larger annual budgets for their TMS programs with reported annual budgets predominantly in the \$100,000-\$500,000 range. MPOs and local agencies have significantly lower budgets for their TMS activities due to their lower centerline coverage and the fact that they obtain the majority of their data from the state DOTs. The evaluation of agencies' most recent six-year budgets for the TMS programs revealed some trends where budgets for certain TMS activities and by specific resourcing method were following increasing or decreasing trends. However, there were no significantly discernable patterns in the yearly budget trends.

D. Summary of Key Findings

D.1. Rationale for Agencies' Resourcing Practices

The majority of agencies that were interviewed are unable to provide an established and documented decision-making process for insourcing or outsourcing their sensor and equipment installation, portable and permanent counts, or other contracting practices. Decisions regarding the type of contracting practice appeared to be strongly influenced by the agencies' history with contracting mechanisms, the agency culture, and several external and internal factors. Primarily, external factors had an influence on the agencies' decisions for outsourcing, and internal factors for the insourcing. The specific external or internal factors varied among the agencies. However, based on the discussions during the interviews, outsourcing agencies generally stated that their decision to outsource is a "response" to challenges that are beyond their offices' control. On the other hand, the internal factors for insourcing decisions included agency-specific conditions such as trust in agency's in-house staff, flexibility in priorities, favoring the proven in-house technical capabilities and approaches, etc. The following are the key observations on the decision-making rationale for the specific categories.

D.1.1. Category 1 - Sensor and/or Equipment Installation - The current contracting practices of many of the agencies has been in place for a number of years and the decision to utilize current resourcing practices was noted to be a result of several factors such as the following:

- "habitual" contracting practices (i.e., business as usual)
- most feasible approach to completing the tasks under understaffed conditions
- following executive/senior management decisions and/or instructions
- minimizing financial burden and the need for human resource allocation during seasonal downtimes

A recurring theme of the interviews was a lack of adequate departmental staff to maintain the in-house installation capability. Whether the lack of staff was a result of staff caps at the agency (or state) level or inadequacy in internal staff allocation, this factor appeared to preclude many agencies from having the option of insourcing equipment installations, thus outsourcing their equipment installation activities to third party contractors. An additional concern among the state DOTs that are outsourcing equipment installations is the feasibility of maintaining staffing levels and required equipment to perform installations in-house while the state might only perform a couple installations per year. Because many agencies do not perform installations in the winter months, the in-house crew that would be responsible for installations would need to be reassigned to different work for a large portion of the year. Therefore, outsourcing the installation contracts and taking advantage of the seasonal downtime by shifting the risk to the contractors appears to work for the benefit of an agency from financial and human resource allocation perspectives.

D.1.2. Category 2 - Portable and Permanent Counts - The current resourcing profile of many of the agencies has been in place for a number of years and the decision to utilize current resourcing practices was a result of factors that lie out of the control of those agency departments responsible for actually performing the counts. However, many of the agencies that are outsourcing portable and permanent counts identify inadequate staffing levels as the primary reason for doing so. Available resources in the form of funding and equipment also prevent some agencies from being able to do their counts in-house. Union rules were discussed in interviews, as well as safety concerns for agency employees. Several agencies were limited in their ability or unwilling to send staff to the roadside to perform counts. Without being able to make a decision concerning their resourcing practices, most agencies lack a defined decision-making process. While many agencies are not currently allowed to hire additional staff to complete counts in-house, they are allowed to establish contracts with outside companies to outsource their count program. Though many agencies are forced to outsource counts due to state constraints, there was not a consensus among agencies that outsourcing counts diminish data quality. A recurring theme

throughout the interviews was that having count data collected using in-house staff provides more control and confidence in data integrity. Many agencies feel that in-house staff lives in and around count areas and are therefore more familiar with the historical traffic patterns of area roadways. This familiarity helps agency staff to quickly identify count data that are dramatically different from historical patterns. Being able to detect the errors in count data earlier in the process ensures that agencies do not waste effort by collecting inaccurate data until an error can be identified through automated software.

D.1.3. Category 3 - Other Contracting Methods - Most agencies indicated that they are utilizing their current resourcing practices because the agency has been doing it for many years, and often times many decades. While few of the responding agencies had documented procedures or established decision-making processes, most of them were very knowledgeable about the “informal” process that would be required for implementing changes within their agency. Most agencies perceive the way they are currently collecting, analyzing, and storing data to be the most effective method, and they view non-traditional and innovative methods such as data exchange agreements or data purchase as “supplemental” resources partly because the required quality is not yet available to replace existing methods. Decisions for utilizing non-traditional or innovative contracting methods would largely be made by management and agency officials outside of the actual department conducting TMS activities. Of those agencies who are utilizing innovative contracting methods, whether it is buying data from third party sources, using new technology such as camera and Bluetooth® detectors to gather data, or sharing data with other agencies, the majority were doing so as a supplement to their existing TMS program.

Many agencies are constrained by external forces such as budget, historical procedures in place, staffing levels, etc., thus preventing them from having complete control over their resourcing decisions. Based on the discussions during the interviews, outsourcing agencies generally stated that their decision to outsource is a “response” to challenges that are beyond their offices’ control. The internal factors for insourcing decisions included agency-specific conditions such as trust in agency’s in-house staff, flexibility in priorities, favoring the proven in-house technical capabilities and approaches, etc. The following are some of the key findings/observations.

D.1.4. Staffing Challenges - Many of the interviewed agencies’ decisions are effectively determined by state government decision makers, budgets, and legislatures. Many were forced to find ways to work with the resources that they were provided and this often led them to outsource their equipment installations. The majority of agencies facing this type of situation find it possible to complete their required TMS activities by hiring contractors even though they are prohibited from hiring additional in-house staff. This appeared to be the common theme in the state DOTs response to staff reductions and hiring freezes. Staff roadway safety is a primary concern among agencies when considering insourcing counts. Union rules and the resulting job classifications can also serve as obstacles for agencies considering a change to insourcing counts. In addition, in-house counts require higher staffing levels and equipment maintenance, both of which can be costly.

D.1.5. Decision-making Processes – Many agencies have not undertaken a formal benefit/cost or total cost analyses, or developed a formal decision-making process to determine the resourcing practice that is best for their agency from both a quantitative and qualitative standpoint. Nearly every agency felt that their current resourcing practice yields a better quality product than it would otherwise. Most agencies do not periodically re-examine their existing resourcing practices and the decisions for choosing a particular resourcing method, where the majority of the interviewed agencies stated that they are continuing with the same insourcing or outsourcing practice for 10+ years. While many agencies are not currently allowed to hire additional staff to complete installations in-house, they are allowed to establish contracts with outside companies to outsource equipment installations. Many agencies are forced to outsource their portable and permanent counts due to state budget and staffing constraints, but there was no consensus that outsourcing counts negatively or positively affected count data. Generally, each agency believes that

their current resourcing profile is the best one for their agency and therefore, data quality would only remain the same or suffer if an alternative resourcing practice were pursued. Those agencies that outsource their portable and permanent counts perceive that contractors perform counts quickly, which significantly reduces the length of the count season. These agencies also benefit from not having to employ the in-house staff to perform counts or maintain the necessary count equipment over time. Alternatively, some agencies perceived negatives of outsourcing data collection such as a lack of data control and relatively high costs compared to insourcing.

D.1.6. Institutional Knowledge and Documentation - A large portion of the interviewed DOTs have employees who have been with their agencies for the majority of their careers resulting in a deep institutional knowledgebase. In many instances, the ‘in-house’ knowledge of these employees goes undocumented, causing significant continuity issues when they leave the agency (other opportunities, lateral shift within the agency, or retirement). During the interviews, it was often discussed that the institutional knowledge is key for their operations, and retaining that knowledge is as important as the knowledge itself. The interviewees indicated that they understand the importance of documentation (decision-making, quality control, inspection procedures, contract specifications, etc.) not only for routine continuity of operations, but also for improving the processes and quality control, and ensuring financial efficiency of the operations.

D.1.7. Emerging Technologies, Trends, and Resourcing Practices - Many of the agencies believe that new technologies will soon replace many of the data collection techniques being used today. In the future, some factors are believed to have motivational roles for agencies’ consideration of innovative technologies and contracting methods. These motivational factors were identified as cost saving incentives, reduced/eliminated equipment inventories, reliability of purchased data, and integration of the agencies’ existing systems with the new technologies and data collected using those technologies. The activities under the agencies’ non-traditional or innovative methods cover not only traffic data collection, but also other associated activities for cost savings and effectiveness. Example activities include development of databases (e.g., regional public-access database to reduce staff time for request processing), expanding capabilities of software platforms, creative staffing options (e.g., engineering interns), QA/QC of obtained or purchased data, documentation process (i.e., using doctoral students to code software and documentation), to name a few. Knowledge and technology transfer (KTT) was one of the themes that emerged during the interviews and agencies use KTT as a means to capitalize on the institutional knowledge gained elsewhere or while developing/operating another relevant program. Currently, there are not many incentives or driving forces for the outsourcing agencies to acquire new technologies to insource the data collection or seek data purchase from third party vendors. However, at one point in the future, it could be more feasible to outsource all data collection activities so that the agencies do not have to maintain and keep up with rapidly evolving technologies. In addition to the reduced or eliminated need for technology upkeep and equipment inventories, the incentive could be cost savings “as more and more data is available, it becomes a fraction of the cost of the agency’s in-house data collection.” Obviously, these motivational factors will have to evolve parallel with the emerging of the technologies and the innovative contracting policies that the agencies will develop/adopt to take advantage of the new and innovative technologies.

E. Conclusions

While traffic count data is mandated by Federal law and is critical to a robust national Highway pavement management System (HPMS), nearly every agency, at all levels of government, utilize different strategies to collect their required data. Every interviewed agency utilized a unique strategy that generally works for them and few respondents noted any improvements that could be made to their portable and permanent count program practices. Even though the decisions to pursue a particular resourcing profile are sometimes beyond the control of agencies that are performing counts, there was not a consensus that

one particular resourcing strategy resulted in higher quality count data. Ultimately, no single approach was identified that would work for all agencies. Each agency installing traffic counting equipment and performing counts exhibits different characteristics, has different needs, and must work within varying state political climates. Each agency must evaluate the options available to them to choose the most suitable resourcing profile for their traffic monitoring system and program activities. While the ultimate resourcing profile of each agency will vary, best practices for developing and maintaining these profiles include thorough documentation of QA/QC procedures and sound resourcing rationale. It is also a good practice to give consideration to the flexibility of the software platforms that the agencies are using or planning to deploy. During implementation of software and database systems, it is important that not only are they scalable to address the agencies' growing data needs, but also capable of having the necessary flexibility to accommodate data collected by newer technologies, obtained from other agencies through agreements, gathered from ITS devices, or purchased from third party vendors.

F. Strategies for Decision Support

There are several factors, advantages, and disadvantages that need to be considered in order for the agencies to evaluate their current practices and develop a roadmap/direction for their future practices. Suggested decision-support processes for currently insourcing or outsourcing agencies are provided in *Figures 10-1* and *10-2* in *Chapter 10, Section 10.1*.

F.1. Factors Supporting Insourcing

- Long-term insourcing would allow the agency to gain in-house technical capabilities and localized expertise, which could be superior to the contractors' general expertise/knowhow (also referred as "building core competence")
- Cost of insourcing could be favorable when compared to outsourcing (*see following sections*)
- Quality of in-house product (data, installation, process, etc.) is superior to contractors' products/service
- Integration of associated activities needs to be streamlined (data processing, QA/QC, HPMS upload, mapping and publications)
- Capital outlay for equipment and technology already occurred (or shared with other departments)
- A portion of the fixed overhead is already absorbed by other departmental functions
- Funding for recurring costs are already budgeted (building rent, vehicle financing, communications, maintenance, supplies)

F.2. Advantages of Insourcing

- Predictability in workforce needs and schedules throughout the year/season
- In-house personnel can have shorter response times for changes in schedules or plans
- Improved control over the processes, operations, and program prioritization
- Builds core competence and, if documented, improves continuity
- Quality is predictable and consistent regardless of the installer or data collector
- Higher degree of accountability within the organization due to visibility
- Not dependent on any contracting mechanism (i.e., no need to expend procurement, legal, and contracting resources)
- Not dependent on contractors (in cases where reliability, quality, and responsiveness are concerned)
- Economies of scale principles apply to insourcing, were the marginal cost of additional units are minimal when compared to outsourcing
- Using the economies of scope principles, the knowhow gained during long-term insourcing could be transferred to other relevant areas where outsourcing can be replaced by insourcing

F.3. Disadvantages of Insourcing

- Requires capital outlay
- Requires in-house technical capabilities (equipment, training, staff)
- Requires dedicated staff and technical support personnel
- If processes and procedures are not documented, jeopardizes continuity of operations when staff leaves
- Could result in excess workforce during seasonal suspension of activities
- External factors/constraints that force staff reduction or prevent adding workforce through hiring freezes
- Requires budgeting for recurring costs such as building rental, vehicle maintenance, communications, etc.
- Requires to maintain and update inventory by salvaging and replacing equipment
- Requires periodic maintenance/calibration of equipment
- Specialized equipment cannot be used for other purposes (except construction equipment that can be used by multiple departments)

F.4. Factors Supporting Outsourcing

- Contractors have specialized expertise
- Mobilization of contractors can be more rapid than in-house personnel
- During high-volume activity requirements, the contractors can pull additional resources from within their organization (equipment, material, workforce)
- Competitiveness of the market could make cost of outsourcing favorable
- Could provide relief for seasonal needs/fluctuations of full- or part-time workforce
- Is not directly affected by external decisions for workforce reduction or hiring freezes such as decisions by the state legislators or higher-level management within the agency
- Capacity constraints
 - Agency does not have in-house human resources
 - Agency does not have in-house technical capabilities
- Quality of contractors' product (data, installation, process, etc.) may be superior compared to in-house products/service
- Agency has funding constraints for capital outlay
- Agency has funding constraints for recurring costs (building rent, vehicle financing, communications, maintenance, supplies)
- Desire not to keep equipment inventory due to low current usage and future usage projections
- Desire not to maintain agency equipment due to costs associated with wear and tear (extensive use) or minimal use

F.5. Advantages of Outsourcing

- Greater flexibility in workforce needs during peak or suspension periods (or seasonal needs)
- Greater predictability in resource allocation of in-house staff
- Reduced or eliminated capital investment (and lower financial risk associated with it)
- Improved predictability and control of funding allocation and spending

F.6. Disadvantages of Outsourcing

- Quality of the data and services will depend on the contractors' "standards"
- If the agency is not satisfied with the quality of data/installation or the service, the process to terminate contracts and re-open procurement could be lengthy
- Outsourcing any activities for an extended period would prevent the agency from developing in-house technical knowledge or expertise (also referred as "losing core competence")

- The agency would have minimal to no control on the process of how an installation is completed or how data is collected
- The volume of activities is dependent on funding availability
- If outsourcing does not work after a while, continuity of equipment installation and data collection could be jeopardized due to lack of in-house processes, procedures, and knowhow
- Operational aspects such as prioritization are somewhat inflexible
- The cost of one additional unit of short-term portable count remains the same when outsourced, but following the principles of economies of scale, the marginal cost is minimal when data collection is performed in-house

F.7. Decision-support Factors

In addition to the advantages and disadvantages, there are benefits and disbenefits associated with the selected resourcing method. The following are the factors that need to be evaluated in detail in order to determine if they provide a benefit or disbenefits to the agency.

- *Before/after comparison of data/installation quality* - Quality of data is superior or inferior when insourced and outsourced data are compared to one another (requires before/after comparison of sample data sets from insourced and multiple outsourced resources).
- *Total cost analysis* - The overriding factor of “total cost” in considering insourcing versus outsourcing TMS activities can be determined by performing a total cost analysis. This type of analysis would allow any agency to be able to compare the costs associated with the insourcing of the activities versus outsourcing them. In order to be able to make an informed comparison, the costs associated with all the elements need to be included in the analyses. There are also several additional considerations involving agency-specific decisions such as staffing, equipment, software, contractor costs, inspection costs, salvaging equipment, data quality requirements, current and future scale of the operations, and other overhead costs. A total cost evaluation template for short-term count activities is provided in *Chapter 10, Section 10.4.1*, and additional considerations are provided in *Section 10.5*.