

Assessment of Insourcing/ Outsourcing Practices for Traffic Monitoring Data Collection

Final Report

FHWA Publication No. PL-16-024

April 2016



U.S. Department of Transportation
Federal Highway Administration

Technical Report Documentation Page

1. Report No. PL-16-024	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Assessment of Insourcing/Outsourcing Practices for Traffic Monitoring Data Collection		5. Report Date April 2016	
7. Author(s) Hunter McCracken, Murat Omay, Jeremy Schroeder, Chris Toth		6. Performing Organization Code	
9. Performing Organization Name And Address Battelle Memorial Institute 505 King Avenue Columbus, Ohio 43201		8. Performing Organization Report No. 100064993-04	
12. Sponsoring Agency Name and Address Office of Policy and Governmental Affairs Office of Highway Policy Information Federal Highway Administration U.S. Department of Transportation 1200 New Jersey Avenue, SE Washington, DC 20590		10. Work Unit No. (TRAIS)	
15. Supplementary Notes Steven Jessberger (FHWA) - Project Manager Daniel Jenkins (FHWA)		11. Contract or Grant No. DTFH61-13-D-00012, Task Order No. 0006	
16. Abstract 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. Part of their role includes collecting quality data for a vast array of uses for their own internal programs, Federal uses and the general public. State DOT highway travel monitoring program personnel is continually challenged to maintain or expand their programs as well as implement advanced traffic monitoring technologies such as highway traffic monitoring data collection hardware and traffic statistics data management software. Over the years, numerous changes have occurred in the technologies available, improvement in quality of the traffic counting methods, the need for more efficient traffic counting programs and expanded scope of traffic data collection. Changes in how these traffic counting functions are performed 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). This report presents the findings of the assessment of state DOTs, MPOs, and local transportation agencies' resourcing practices for all aspects associated with traffic data collection activities under three categories: 1) equipment installation, 2) permanent and portable counts, and 3) other/non-traditional contracting practices. The report shares the insight that was gained into the rationale behind agencies' decision-making processes by collecting data from approximately 80 agencies and conducting interviews with approximately 30 agencies throughout the U.S. The 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.		13. Type of Report and Period Covered Final Report	
17. Key Words Traffic Data Collection, Highway Traffic Monitoring, Permanent and Portable Counts, Insourcing and Outsourcing Practices, Traffic Monitoring Program Decision-making Process		14. Sponsoring Agency Code HPPI-1	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 210	22. Price

Executive Summary

Introduction

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 (outsourcing) various parts of their counting program while others have continued to perform their activities using their own internal staff (insourcing).

The research goal is 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.

Summary of Key Observations

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 was 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.

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. 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, 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.

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.

Many agencies feel that in-house staff live 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. 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.

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. Staff roadway safety is a primary concern among agencies when considering insourcing counts. Many of the agencies believe that new technologies will soon replace many of the data collection techniques being used today.

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. 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.

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*.

Table of Contents

1.0	INTRODUCTION AND BACKGROUND	8
1.1	Research Need	8
2.0	RESEARCH METHODOLOGY.....	9
2.1	Overview and TMS Activity Categories.....	9
2.2	Technical Panel.....	10
2.3	Research Phases	10
2.3.1	Information Gathering	11
2.3.2	Web-based Assessment.....	11
2.3.3	Distribution of Questions to the Participants	13
3.0	DEMOGRAPHICS OF THE RESPONDENTS	14
4.0	ANALYSIS OF THE RESPONSES TO WEB ASSESSMENT	18
4.1	Staffing Levels and Resources.....	18
4.2	Dedicated Vehicles for TMS Activities	22
4.3	Overall Resourcing Profiles by Agency Type, Category, and TMS Activity.....	22
4.4	Resourcing Profiles for TMS Activities by Agency Type	27
4.5	Quality Assurance and Quality Control (QA/QC) Process.....	28
4.6	QA/QC of Outsourced Traffic Counts	31
4.7	Decision-making Process.....	32
4.8	Decision-makers for Agencies’ In/Outsourcing Practices	35
4.9	Annual Budget Allocations for TMS Activities	37
4.9.1	Most Recent Year Budget and Spending	37
4.9.2	Most-recent Six-year Budget Trends	38
4.10	Evaluation of TMS Activity Unit Costs.....	38
5.0	INTERVIEW PROCESS AND EVALUATIONS	42
5.1	Development of Agency Profiles.....	42
5.1.1	Agency Selection	42
5.1.2	Interview Questions	46
6.0	ASSESSMENT OF CATEGORY 1 ACTIVITIES -EQUIPMENT AND/OR SENSOR INSTALLATION	48
6.1	Description of TMS Sensor and Equipment Installation Services.....	48
6.2	Agency Resourcing Profiles	48
6.3	Agency Interviews and Evaluation of Responses	49
6.3.1	Interview Questions	49
6.3.2	Summary of Interview Discussions	51
6.4	Rationale for Agencies’ Resourcing Practices for their Sensor and/or Equipment Installation	71
6.5	Experiences, Challenges, and Success Stories of Agencies for Sensor and/or Equipment Installation Activities	72
6.6	Summary of Best Practices reflecting Cost and Time Efficiency, Effectiveness, and Reliability for Sensor and/or Equipment Installation Activities	72
6.7	Perceived Advantages and Disadvantages of Insourcing or Outsourcing Sensor and/or Equipment Installation.....	73
6.8	Summary of Findings – Category 1 Activities.....	74
6.9	Conclusions– Category 1 Activities.....	75
6.10	Recommendations – Category 1 Activities.....	76
7.0	ASSESSMENT OF CATEGORY 2 ACTIVITIES – PORTABLE AND PERMANENT COUNTS	77
7.1	Description of TMS Sensor and Equipment Installation Services.....	77
7.2	Agency Resourcing Profiles	77
7.3	Agency Interviews and Evaluation of Responses	77

	7.3.1	Interview Questions	78
	7.3.2	Summary of Interview Discussions	80
	7.4	Rationale for Agencies’ Resourcing Practices for Portable and Permanent Counts.....	103
	7.5	Experiences, Challenges, and Success Stories of Agencies for Portable and Permanent Counts	103
	7.6	Summary of Best Practices reflecting Cost and Time Efficiency, Effectiveness, and Reliability for Portable and Permanent Counts.....	103
	7.7	Perceived Advantages and Disadvantages of Insourcing or Outsourcing Portable and Permanent Counts	105
	7.8	Summary of Findings - Category 2 Activities	106
	7.9	Conclusions - Category 2 Activities	107
	7.10	Recommendations - Category 2 Activities	108
8.0		ASSESSMENT OF CATEGORY 3 ACTIVITIES – OTHER CONTRACTING METHODS.....	109
	8.1	Description of other Contracting Services	109
	8.2	Agency Resourcing Profiles	109
	8.3	Agency Interviews and Evaluation of Responses	110
	8.3.1	Interview Questions	110
	8.3.2	Summary of Interview Discussions	113
	8.4	Rationale for Agencies’ Resourcing Practices for Other Contracting Methods	126
	8.5	Experiences, Challenges, and Success Stories of Agencies for Other Contracting Methods	126
	8.6	Summary of Best Practices reflecting Cost and Time Efficiency, Effectiveness, and Reliability for Other Contracting Methods	127
	8.7	Perceived Advantages and Disadvantages of Other Contracting Methods.....	128
	8.8	Summary of Findings - Category 3 Activities	128
	8.9	Conclusions - Category 3 Activities	129
	8.10	Recommendations - Category 3 Activities	129
9.0		SUMMARY OF REPORT FINDINGS	130
	9.1	Demographics of the Participating Agencies.....	130
	9.2	Observed Trends on the Data Collected using the Web-based Assessment	131
	9.2.1	Staffing Levels and Resources.....	131
	9.2.2	Resourcing Profiles for TMS Activities by Agency Type	131
	9.2.3	Quality Assurance and Quality Control (QA/QC) Process.....	131
	9.2.4	Decision-making Process.....	131
	9.2.5	Current Year Budgets	132
	9.2.6	Most-recent Six Year Budget Trends (2010-2015)	132
	9.2.7	Evaluation of Reported Unit Costs	132
	9.3	Interviews with the Agencies.....	133
	9.3.1	Category 1 Interviews (Equipment and Sensor Installation)	133
	9.3.2	Category 2 Interviews (Permanent and Portable Counts).....	134
	9.3.3	Category 3 Interviews (Other Contracting Methods)	135
10.0		STRATEGIES FOR DECISION SUPPORT.....	136
	10.1	Decision-support Considerations for TMS Activities.....	136
	10.2	Supporting Factors, Advantages, and Disadvantages of Insourcing.....	138
	10.2.1	Factors Supporting Insourcing.....	138
	10.2.2	Advantages of Insourcing	138
	10.2.3	Disadvantages of Insourcing.....	139
	10.3	Supporting Factors, Advantages, and Disadvantages of Outsourcing	139
	10.3.1	Factors Supporting Outsourcing	139
	10.3.2	Advantages of Outsourcing	140
	10.3.3	Disadvantages of Outsourcing	140

10.4	Cost and Quality Factors for Insourcing or Outsourcing Decisions	140
10.4.1	Total Cost Analysis.....	141
10.5	Additional Considerations for Total Cost or Benefit/Cost Analysis Framework	147
APPENDIX A – List of Acronyms		
APPENDIX B - Qualification Questions		
APPENDIX C – Detailed Questions		
APPENDIX D – Most Recent Six-Year Budget Trends		
APPENDIX E – Available and Provided Data for Agencies Responding to Online Assessment		
APPENDIX F – Information for Selected Agencies		
APPENDIX G - Interview Questions		
APPENDIX H – Pennsylvania Department of Transportation (PennDOT) Cost Analysis Worksheet		

List of Figures

Note: the source for all figures in this document is Battelle Memorial Institute

Figure 3-1. Functional Role of Assessment Respondents.....	14
Figure 3-2. Number of Continuous Counting Stations (CCS) owned by the responding State DOTs	15
Figure 3-3. Number of Weigh-in-Motion (WIM) Stations owned by the responding State DOTs	15
Figure 3-4. Number of Annual Short-term Counts reported by the State DOTs	16
Figure 3-5. Number of Annual Short-term Counts reported by the MPOs.....	16
Figure 3-6. Number of Annual Short-term Counts reported by the Local Transportation Agencies.....	17
Figure 4-1. Number of Dedicated TMS Staff reported by the State DOTs	18
Figure 4-2. Distribution of Dedicated TMS Staff reported by the MPOs.....	19
Figure 4-3. Number of Dedicated TMS Staff reported by the Local Agencies	19
Figure 4-4. Average Number of Full-time Staff by Resourcing Profile for Select TMS Activities	20
Figure 4-5. Average Number of Part-time Staff by Resourcing Profile for Select TMS Activities	21
Figure 4-6. TMS Insourcing/Outsourcing Profile of Responding Agencies' Category 1 Activities	23
Figure 4-7. TMS Insourcing/Outsourcing Profile of Responding Agencies' Category 2 Activities	24
Figure 4-8. TMS Insourcing/Outsourcing Profile of Responding Agencies' Category 3 Activities	25
Figure 4-9. Number of Years Responding Agencies has been Insourcing/Outsourcing TMS Activities	26
Figure 4-10. Resourcing Profile for Activities by Agency Type (all categories combined).....	27
Figure 4-11. Distribution of Resourcing Profile for Activities by Agency Type	28
Figure 4-12. Presence of Documented QA/QC Process by Agency Type.....	29
Figure 4-13. Distribution of Presence of Documented QA/QC Process.....	29
Figure 4-14. Documented Quality Control and Quality Assurance Process by Resourcing Profile for Select TMS Activities.....	30
Figure 4-15. Distribution of the Documented Quality Control and Quality Assurance Process by Resourcing Profile for Select TMS Activities.....	31
Figure 4-16. Availability of Documented Decision-Making Process for TMS Activities by Agency Type.....	32
Figure 4-17. Documented Decision-making Process by Resourcing Profile for Select TMS Activities	34
Figure 4-18. Distribution of the Documented Decision-making Process by Resourcing Profile for Select TMS Activities	34
Figure 4-19. Distribution of Decision-makers among the Three TMS Activity Categories	35
Figure 4-20. Current Agency Budgets by Agency Type and by TMS Activity Category	37
Figure 10-1. Insourcing Decision-support Process	136
Figure 10-2. Outsourcing Decision-support Process	137
Figure D-1. Distribution of Annual Budgets – Category 1 (Intrusive CCS Sensor Installation)	
Figure D-2. Distribution of Annual Budgets – Category 1 (CCS and Equipment Controller Cabinets or Complete CCS Site Installation)	

- Figure D-3. Distribution of Annual Budgets – Category 1 (Site Installations including Communication and Power)
- Figure D-4. Distribution of Annual Budgets – Category 1 (Non-intrusive Sensor Installation)
- Figure D-5. Distribution of Annual Budgets – Category 2 (Portable Manual Counts)
- Figure D-6. Distribution of Annual Budgets – Category 2 (Volume Counts, Classification Counts, Speed Measurements)
- Figure D-7. Distribution of Annual Budgets – Category 2 (Weight Measurements)
- Figure D-8. Distribution of Annual Budgets – Category 3 (Paying for Quality Data for a Given Time – QA/QC by Contractor)
- Figure D-9. Distribution of Annual Budgets – Category 3 (Paying for Quality Data for a Given Time – QA/QC by Agency)
- Figure D-10. Distribution of Annual Budgets – Category 3 (Equipment Sharing Agreements with Other Agencies)
- Figure D-11. Distribution of Annual Budgets – Category 3 (Coordination of Non-traditional Sources to Obtain Counts)
- Figure D-12. Distribution of Annual Budgets – Category 3 (Integration of the TMS Data into the Agency's or Regional Archived Data User Service - ADUS)
- Figure D-13. Distribution of Annual Budgets – Category 3 (Management and Quality Control of Data Feeds into Regional Transportation Data Portals/Archives)
- Figure D-14. Distribution of Annual Budgets – Category 3 (Publication of Annual TMS Reports, Traffic Volume Maps, Trends, Data Tables, Graphs, and GIS Shape Files)

List of Tables

Note: the source for all tables in this document is Battelle Memorial Institute

Table 2-1. Number of Agencies selected for Detailed Assessment.....	10
Table 4-1. Overall Staffing Profiles of the Agencies by resourcing Profile for Select TMS Activities.....	20
Table 4-2. Reported Agency Vehicle Ownership Exclusively for TMS Activities.....	22
Table 4-3. Resourcing Practices by Agency Type (three categories combined)	27
Table 4-4. Documented Quality Control and Quality Assurance Process by resourcing Profile for Select Activities.....	30
Table 4-5. Documented Decision-making Process by Resourcing Profile for Select TMS Activities)	33
Table 4-6. Distribution of Responses Identifying Decision-making Groups	36
Table 4-7. Cross-tabulation Matrix for Matching the Activities Under the Unit Cost and TMS Categories.....	39
Table 4-8. Unit Costs as reported by the Agencies and Based on an Average of Lower and Upper Bound of Each Cost Category	40
Table 5-1. Profiles of the selected Agencies under each TMS Activity Category	44
Table 5-2. Insourcing/Outsourcing Profiles of the selected Agencies under each TMS Activity Category	45
Table 6-1. List of Agencies that were selected for Category 1 Interviews Their Resourcing Profiles.....	49
Table 6-2. Observed Internal and External factors influencing Agency Decisions.....	60
Table 7-1. List of Agencies that were selected for Category 2 Interviews and Their Resourcing Profiles.....	77
Table 8-1. List of Agencies Selected for Category 3 Interviews and Their Resourcing Profiles.....	110
Table 8-2. Noteworthy Non-traditional Contracting Methods under Category 3 Activities	113
Table 10-1. Typical Cost Items for Short-term Portable Traffic Counts.....	142

Notice

This document is distributed by the U.S. Department of Transportation, in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturer's name or products are mentioned, it is because they are considered essential to the objective of the publication and should not be considered as an endorsement. The United States Government does not endorse products or manufacturers.

The product costs table from specific vendors are included in this report for cost comparison purposes and should not be considered a complete list of products and vendors. This report also does not constitute a standard, specification, or regulation.

1.0 INTRODUCTION AND BACKGROUND

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. Traffic data are collected by the state departments of transportation (DOTs), local transportation agencies, and Metropolitan Planning Organizations (MPOs) under their traffic data collection, travel monitoring programs, or traffic monitoring systems (TMSs). Traffic data are used by FHWA, States and local agencies for the Federal-aid highway program including but not limited to project and program planning, National Environmental Policy Act (NEPA) and related environmental studies and analysis, project design, construction, maintenance, finance, revenue, and performance management.

1.1 Research Need

Given the traffic data demand from all stakeholders involved in transportation programs and project development processes, and the fact that each State DOT and MPO is organized differently with unique budget and organizational structures, agencies have adopted a wide range of practices for collecting and processing traffic data. Agencies (i.e., state DOTs, MPOs, and local transportation agencies such as county and municipal governments) may collect all data in-house (i.e., insourcing) or by partially or fully contracting the work to outside consultants and contractors (i.e., outsourcing). For the purpose of this document, 'insourcing' is used to describe activities that are fully or partially performed by an agency's in-house (or internal) financial, human, and capital resources. Conversely, 'outsourcing' is used to describe activities that are fully or partially contracted to entities that are unaffiliated external third parties to the agency that is outsourcing the tasks. In the cases of partial insourcing or outsourcing, activities in both categories occur at varying levels. There is limited documentation regarding the decision-making processes that support decisions for insourcing or outsourcing of the state DOTs and other agencies' traffic monitoring program activities. For this effort, it was important to document the factors that influence an agency's decision in choosing to either partially or fully insource or outsource activities because the factor that the agency is trying to control for would be the vital contributing factor in the determination of the in/outsourcing distribution proportion for the agency.

The purpose of this research was to assess the advantages and disadvantages that agencies experience by insourcing and/or outsourcing all aspects associated with traffic data collection activities under three categories: equipment installation, permanent and portable counts, and non-traditional contracting practices. From this effort, insight was gained into the rationale behind agencies' decision-making processes by collecting data from and conducting interviews with a select number of agencies throughout the U.S. This report summarizes the findings regarding agency practices for resourcing (in- or outsourcing) of certain traffic monitoring activities, as well as some of the rationale behind their resourcing decisions. The audience of this report is practitioners primarily involved in the decision-making and implementation of Traffic Monitoring System (TMS) programs and similarly, those involved in the planning and operational aspects of the TMS activities.

The objective of the research was to gather and analyze the related information in order to highlight the advantages and disadvantages of in/outsourcing of traffic monitoring activities. The report provides a comparison of fully-insourced counting programs to the fully-outsourced programs, agency practices that fall in between these two extremes, and then provides a summary of each agency studied to include a national-level summary. The ultimate goal is to help agencies involved in traffic data collection and processing make informed decisions when considering in/outsourcing.

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

2.0 RESEARCH METHODOLOGY

2.1 Overview and TMS Activity Categories

Participating agencies for this research effort were identified based on their level of involvement in TMS program activities such as the installation of data collection equipment, collection of data, and purchase or obtainment of data through other mechanisms such as interagency or regional agreements, or through the purchase of quality data. Such agencies completed the assessment questions and a number of which were then selected for follow-up phone interviews for additional information. The information presented in this document is a summary of responses received through questionnaires and phone interviews.

TMS Activity Categories - As a result of institutional knowledge and preparatory investigation, it was determined that categorizing the traffic monitoring activities was a logical approach. State DOTs, MPOs, and local agencies have different contracting approaches to traffic data collection equipment installation, the activity of traffic data collection, and non-traditional methods/agreements for traffic data purchase. Therefore, the research questions, interview questions, and selection of agencies were based on these three main categories of the following traffic monitoring system activities, along with the typical elements in each category (for elements not included in the list, an option was given to the respondents to include items and their descriptions under a category labeled as “other”):

Category 1 - Permanent Sensor and/or Equipment Installation

- Intrusive Continuous Counting Station (CCS) sensors
- CCS and equipment controller cabinets or complete CCS site installation
- Pull boxes (including lead-in wires and cables)
- Site installations including communication and power (including portable power sources)
- Non-intrusive sensor installation (e.g., radar, passive infrared, ultrasonic, acoustic, CCTV, SmartSensors™)

Category 2 - Portable and Permanent Counts

- Portable manual counts (video, in-person, or electro-mechanical)
- Portable volume counts, classification counts and speed measurements (intrusive and non-intrusive)
- Permanent volume counts, classification counts and speed measurements (intrusive and non-intrusive)
- Weight measurements (both permanent or portable weigh-in-motion [WIM])

Category 3 - Other Contracting Methods

- Paying for quality data for a given time period (contractor obtained and quality-controlled by the agency)
- Buying data from other sources such as global positioning system (GPS), probe-based data (e.g., INRIX™), or data collected by vendors using video detection (e.g., MioVision™)
- Equipment sharing techniques and agreements with other agencies
- Coordination of non-traditional sources to obtain counts such as data exchange/sharing agreements with other organizations or agencies, or interdepartmental agreements such as traffic data collected by ITS
- Integration of the TMS data into the agency’s or regional Archived Data User Service (ADUS)
- Management and quality control of data feeds into regional transportation data portals/archives (e.g., RITIS©, iPeMS®, DriveNet™)
- Publication of annual TMS reports, traffic volume maps, trends, data tables, graphs, and geographic information system (GIS) shape files

2.2 Technical Panel

A technical panel was established to monitor research progress and provide feedback at critical milestones, including the evaluation of questions in the web-based assessment, selection of agencies to interview, and review of interview questions. The technical panel included the following individuals with over 80 collective years of relevant experience with regard to traffic data collection activities:

- Dorothy Aydelotte – Idaho Transportation Department (ITD)
- Andrea Bahoric – Pennsylvania DOT (PennDOT)
- Chade Saghir – Southeastern Michigan Council of Governments (SEMCOG)
- Thomas Schinkel – Virginia DOT (VDOT)
- James Teeter – South Carolina DOT (SCDOT)
- Chris Zajac – New Jersey DOT (NJDOT)

2.3 Research Phases

The objective of phasing the research was to develop a comprehensive method to examine the current contracting practices of a selected group of 15 state DOTs and a combination of nine MPOs and local agencies that are representative across the two extremes of the in/outsourcing spectrum (i.e., fully or partially insourced or outsourced) for their TMS activities. Table 2-1 shows the number of agencies that were selected for detailed assessments and interviewed as part of this research project:

Table 2-1. Number of Agencies selected for Detailed Assessment

Agency Type	Category 1	Category 2	Category 3	Combined
State DOT	8	8	4	20
MPO & Local Agency	3	4	4	11
TOTAL	11	12	8	31

Research was developed and carried out using the following phasing, and is described in further detail in the subsections below:

- *Information Gathering* – preliminary information gathering was performed regarding the traffic data collection activities of state DOTs, MPOs, and local agencies to determine which criteria would be used in developing “agency resourcing profiles” and “agency characteristics.”
- *Web-based Assessment* – a two-stage questionnaire, structured to consist of “qualification” and “detailed” questions, where responses to the first set of questions led to selection of several agencies of interest and proceed with the second set of more detailed questions.
- *Development of Agency Profiles* – the responses to the web-based questionnaire were used to develop agency profiles. The elements/criteria to develop the profiles are discussed in detail in the following sections.
- *Agency Selection* – the profiles were used to select several agencies in each of the three categories, where geographic diversity of the agencies, as well as their size, staffing, funding, and the proportion of their in/outsourcing practices were taken into consideration.
- *Phone Interviews* – a series of interviews were conducted with selected agencies by phone where one or several agency representatives participated in each call.
- *Documentation* – a summary of findings and information that was gathered throughout the research, as well as conclusions to serve as a reference to the agencies that participate in TMS activities.

2.3.1 Information Gathering

This phase of research was comparable to a literature review, where specific documentation and traffic data collection programs of several state DOTs were reviewed for background information. Reviewed documents included guidelines such as:

- FHWA Traffic Monitoring Guide (2013)²,
- FHWA Case Studies of Traffic Monitoring Programs in Large Urban Areas (1997)³,
- FHWA Traffic Detector Handbook: Third Edition—Volume I (2006)⁴,
- FHWA Highway Performance Monitoring System (HPMS) Division Review Guidelines (2015)⁵, and
- Colorado DOT report on State Department of Transportation’s (DOT’s) Travel Monitoring Survey (2007)⁶.

The centerline coverage data of the state DOTs were obtained from the FHWA Highway Statistics - *Public Road Length, Miles by Ownership - Table HM-10* (2011)⁷ for use as one of the representative criteria in determining the size of state DOT traffic data collection operations and coverage.

Additional information gathering activities included research on software systems for traffic data collection and processing to understand the industry-standard software applications, their capabilities, and use among the state DOTs. The traffic monitoring program websites of several state DOTs were reviewed to gain an understanding about their data collection, reporting (to the public and HPMS), and documentation practices.

2.3.2 Web-based Assessment

A web-based tool was used to administer the assessment⁸. The assessment was designed in a way so that it can be redistributed to relevant agency personnel for the purpose of future research updates or if a follow up assessment is needed. Several draft versions and the final version of the questions, responses collected from the agencies (time-stamped), as well as invalidated responses were all stored within the password-protected assessment tool that is accessible only to the designated research team members. The tool’s flexibility also provided an easy platform for modifying, changing, adding, or eliminating questions in the future, as needed. For similar efforts if the FHWA decides to use the assessment at a future date, the questions can be sent to multiple agencies or persons, the responses can be collected within user-defined timeframes, and the responses/analysis results can be shared with multiple members of the research team. Furthermore, a separate security level can be assigned to each person on the team, thus allowing certain members to see the entire assessment.

Two sets of questions were developed for the assessment using the web-based tool. The first set, qualification questions, were developed to determine the basic operational characteristics and contractual practices associated with traffic data collection. The second set, detailed questions were developed for agencies that were to be retained for further evaluation. The detailed questions were optional and the majority of the questions were designed to serve as follow-up questions during the phone interviews with the selected agencies at the later stages of the research.

² <https://www.fhwa.dot.gov/policyinformation/tmguid/>

³ <https://www.fhwa.dot.gov/ohim/casemon.pdf>

⁴ <http://www.fhwa.dot.gov/publications/research/operations/its/06108/06108.pdf>

⁵ <https://www.fhwa.dot.gov/policyinformation/hpms/reviewguide.cfm>

⁶ <http://hermes.cde.state.co.us/drupal/islandora/object/co%3A5116>

⁷ <https://www.fhwa.dot.gov/policyinformation/statistics/2011/hm10.cfm>

⁸ Survey Monkey® (<https://www.surveymonkey.com>)

Qualification Questions

Twelve qualification questions were asked to the participants, where the majority of the response options included “yes,” “no,” and “none or N/A” from a drop-down menu for ease of reference. The qualification questions are listed below, while the formatted version showing the response layout from the web-questionnaire is included in **Appendix B**.

1. How many continuous counting stations (CCS) do you have?
2. How many weigh-in-motion (WIM) stations do you have?
3. How many short-duration traffic counts does your agency collect on an annual basis?
4. Do you have consultant contracts for your agency's TMS data collection activities?
5. What is the number of full-time staff assigned to TMS activities?
6. What is the number of part-time staff assigned to TMS activities?
7. Does your agency own vehicles designated exclusively for TMS activities?
8. Please mark the level of in/outsourcing for each of the TMS activities within the three main categories and the elements in each category. (Note that response options included “fully insourced,” “mostly insourced,” “fully outsourced,” “mostly outsourced,” and “N/A”)
Category 1 - Permanent Sensor and/or Equipment Installation
Category 2 - Portable and Permanent Counts
Category 3 - Other Contracting Methods
9. How many years has your agency been practicing insourcing for the following categories?
Category 1 - Permanent Sensor and/or Equipment Installation
Category 2 - Portable and Permanent Counts
Category 3 - Other Contracting Methods
10. How many years has your agency been practicing outsourcing for the following categories?
Category 1 - Permanent Sensor and/or Equipment Installation
Category 2 - Portable and Permanent Counts
Category 3 - Other Contracting Methods
11. Do you have a documented quality control and quality assurance process (i.e., routinely followed procedures that are reviewed and updated periodically)?
12. Do you have a documented decision-making process for in/outsourcing of your TMS activities (i.e., routinely followed procedures that are reviewed and updated periodically)?

Detailed Questions

There were 51 questions in the detailed questions section. The detailed questions were targeted to understand the specifics of the agencies’ operational and contractual characteristics, as well as the challenges and experiences that the state DOTs, MPOs, or local agencies documented. After the completion of the qualification questions, the respondents were given the option to continue to the detailed questions section. The three options available were, “continue and complete the detailed questions,” “proceed to the detailed questions section and browse the questions,” or “request a reminder email to be sent in several weeks.” As mentioned previously, the majority of the detailed questions were designed to serve as follow-up questions during the phone interviews with the selected agencies at the later stages of the research. The detailed questions were grouped into the following six categories, and the questions can be found in **Appendix C**:

- Agency Operations
- Quality Assurance/Quality Control (QA/QC)
- Decision-making Process
- Data Purchase, or Data and Equipment Exchange/Sharing Agreements
- Contracting Practices
- Software

2.3.3 Distribution of Questions to the Participants

The questionnaire was distributed to potential respondents by emailing a link to the website. The web-based assessment was opened for approximately 6 weeks, providing ample time for the respondents to prepare the information or research the specific responses for their agency (i.e., annual contracts, documentation, staffing, etc.). The questionnaire was designed to remember the unique internet protocol (IP) address of participants, thus allowing them to login to the questionnaire at a later time and continue where they left off at their convenience. The following sections describe the methods that were used to reach out to the state DOTs, MPOs, and local agencies.

State DOTs – The link to the questionnaire was emailed to 210 contact persons in 50 state DOTs and the District of Columbia DOT. These contacts were obtained from FHWA. The majority of the responding state DOTs selected one person to respond to the questionnaire after collaborating internally among staff members.

Metropolitan Planning Organizations (MPOs) – The link to the questionnaire was emailed to approximately 150 persons responsible for transportation planning/traffic engineering at MPOs. The U.S. DOT's database of MPOs was used to identify organizations with relatively large population/coverage areas to receive the questionnaire⁹. Although the Association of Metropolitan Planning Organizations (AMPO) was contacted to assist with distributing the questionnaire to transportation personnel, they were unable to provide assistance to this effort. However, AMPO staff was briefed about the research objectives and the activities in case they were contacted by any of the MPOs who received the weblink directly.

Local Agencies – The National Association of City Transportation Officials (NACTO) and National Association of Counties (NACO) were contacted to reach municipal and county-level transportation agencies. Instead of obtaining individual contact information for the transportation officials at the municipality or county level, NACTO posted the link for the questionnaire on their monthly electronic newsletter and NACO distributed the same information on their listserv email. Because of the distribution methods used to reach out to these groups, the exact number of people reached is unknown.

⁹ U.S. DOT FHWA/FTA Transportation Planning Capacity Building – Metropolitan Planning Organization (MPO) Database (<https://www.planning.dot.gov/mpo.asp>)

3.0 DEMOGRAPHICS OF THE RESPONDENTS

There were 79 unique responses to the qualification questions in the web-based questionnaire. Out of the 79 responses, 41 were from state DOTs, 32 from MPOs, and the remaining six from the local transportation agencies. The respondents' functional roles ranged from technician to administrator, and *Figure 3-1* shows the distribution of the functional role of the respondents.

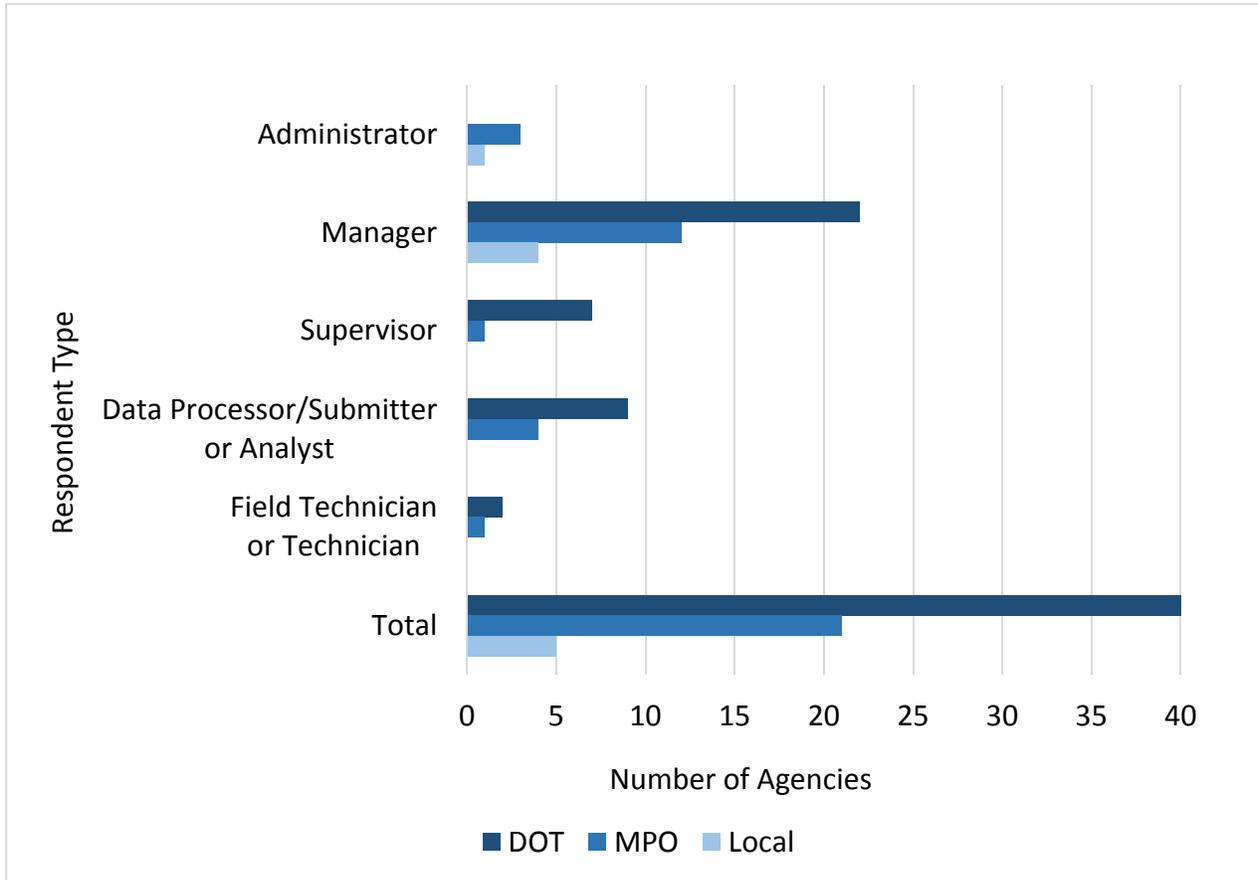


Figure 3-1. Functional Role of Assessment Respondents

Based on the collected responses from the state DOTs, the agencies owned a varying number of continuous counting stations (CCS) and weigh-in-motion (WIM) stations. The range of CCS and WIM stations are shown in *Figure 3-2* and *Figure 3-3*, respectively.

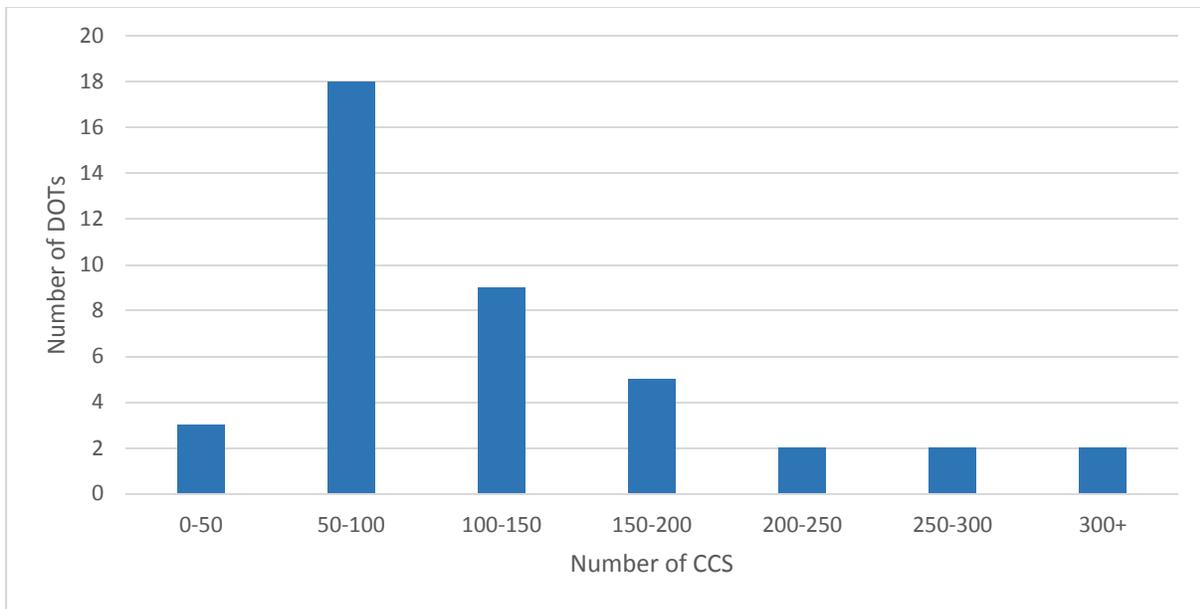


Figure 3-2. Number of Continuous Counting Stations (CCS) owned by the responding State DOTs

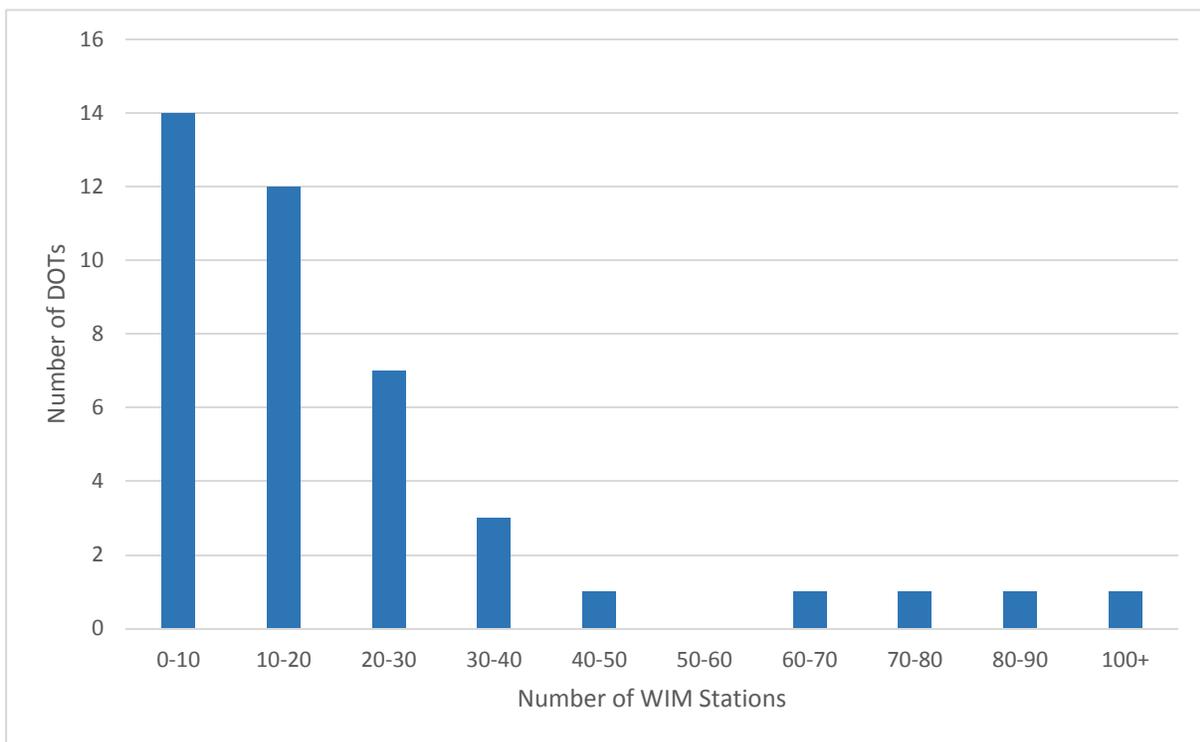


Figure 3-3. Number of Weigh-in-Motion (WIM) Stations owned by the responding State DOTs

The respondents also indicated the number of short-term counts their agencies conduct on an annual basis, which are shown in *Figure 3-4*, *Figure 3-5*, and *Figure 3-6* for state DOTs, MPOs, and local agencies, respectively. Unsurprisingly, the state DOTs undertake anywhere between 2,500 and 15,000+ short-term counts per annum, whereas the number of annual MPO and local agency counts are in the hundreds.

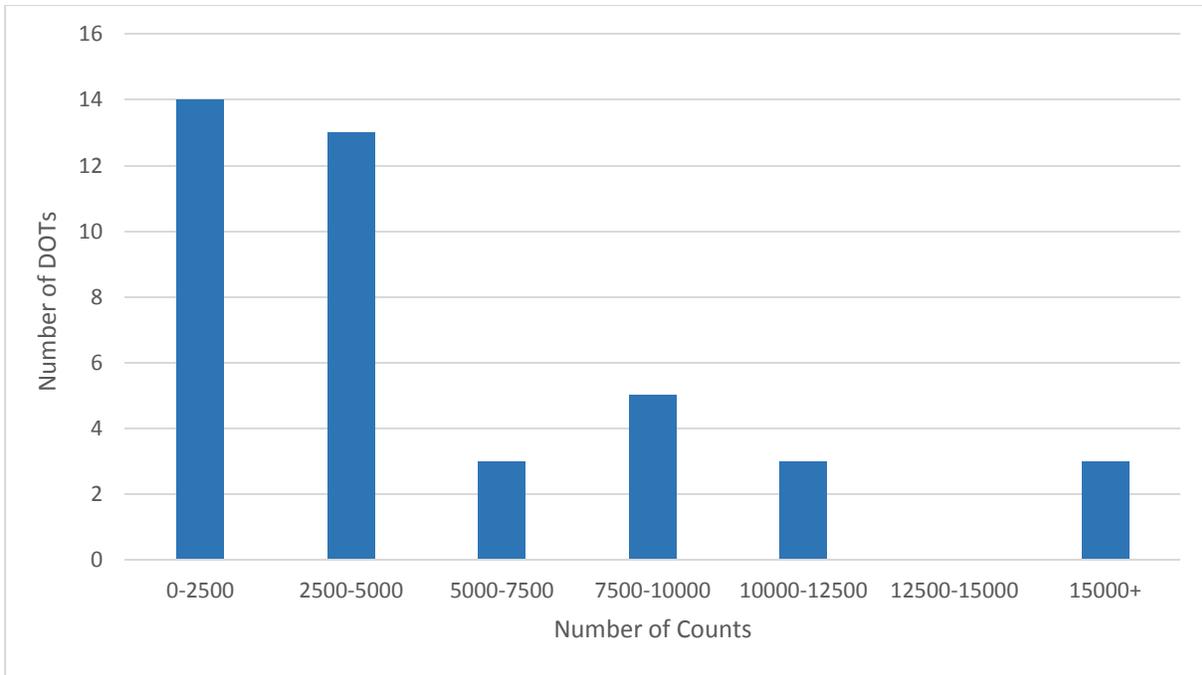


Figure 3-4. Number of Annual Short-term Counts reported by the State DOTs

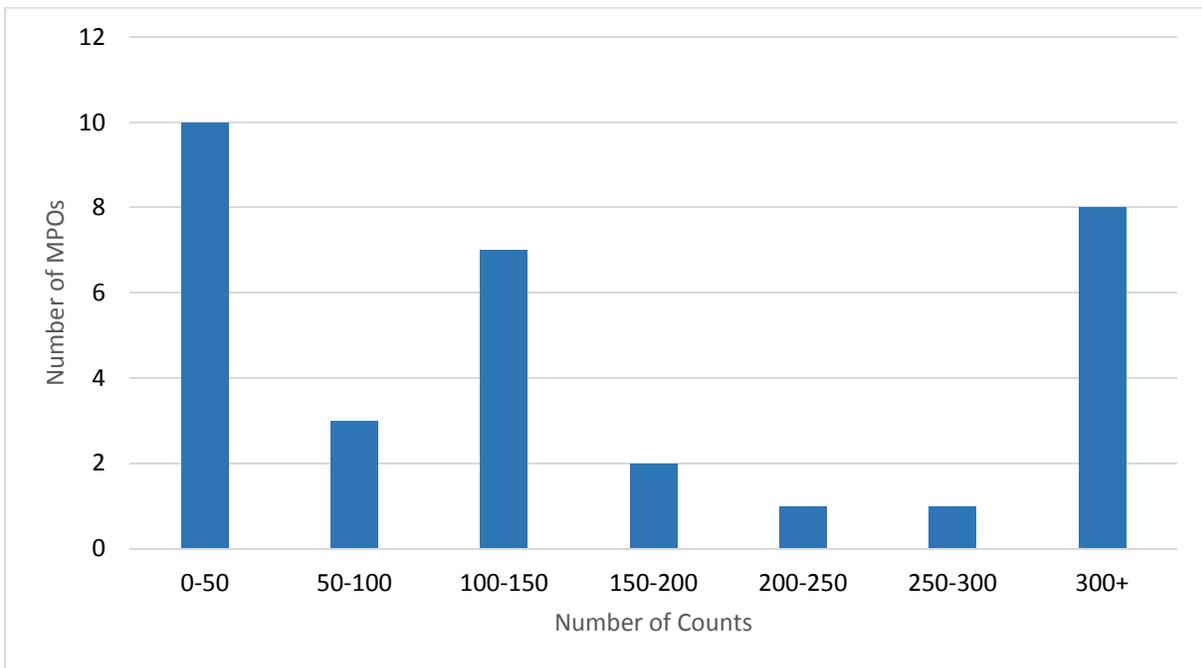


Figure 3-5. Number of Annual Short-term Counts reported by the MPOs

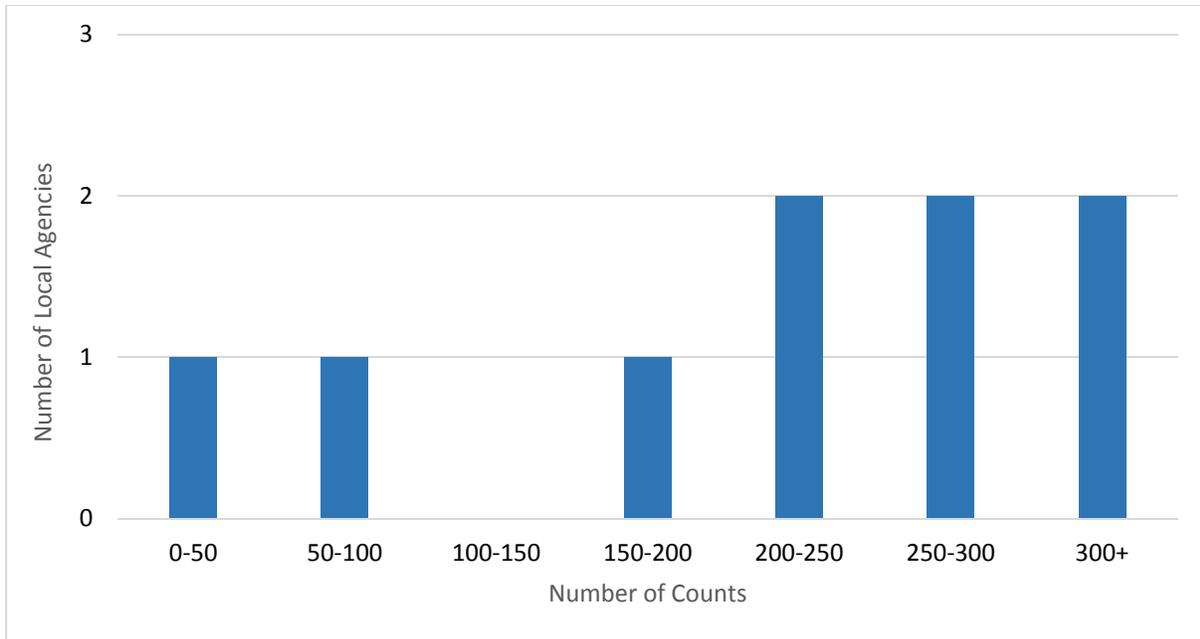


Figure 3-6. Number of Annual Short-term Counts reported by the Local Transportation Agencies

When asked about consultant contracts for TMS data collections:

- Twenty-six responding DOTs reported that they had these contracts, while 14 reported that they did not.
- Fourteen responding MPOs reported that they had these contracts, while 16 reported that they did not.
- Three responding local agencies reported that they had these contracts, while three reported that they did not.

4.0 ANALYSIS OF THE RESPONSES TO WEB ASSESSMENT

The responses provided by the agencies were further evaluated in order to understand if certain trends or patterns could be observed. Caution was used in analyzing the data or presenting any observations/conclusions where limited data points were available. However, some general observations were developed using the limited number of data points. The team used these preliminary observations to formulate the interview questions for the later parts of the research. The interview questions were designed to seek detail about the agencies' processes and procedures, as well as to validate or invalidate the preliminary observations from the web-based assessment responses. The following sections summarize the collected data and their evaluations under the key question categories and where adequate number of data points was available for meaningful evaluations.

4.1 Staffing Levels and Resources

The distributions of staff members (office and field) by agency type are depicted in *Figure 4-1*, *Figure 4-2*, and *Figure 4-3* and as follows:

- Responding DOTs reported an average of 10.9 full-time staff members for TMS activities and an average of 2.2 part-time staff members. Among these, the highest number of full-time staff members was 30 (California) and the lowest was one (District of Columbia and Delaware).
- Responding MPOs reported an average of 1.5 full-time staff members dedicated to TMS activities and 0.6 part-time staff members.
- Local agencies reported an average of 1.8 full-time staff members dedicated to TMS activities and 0.8 part-time staff members.

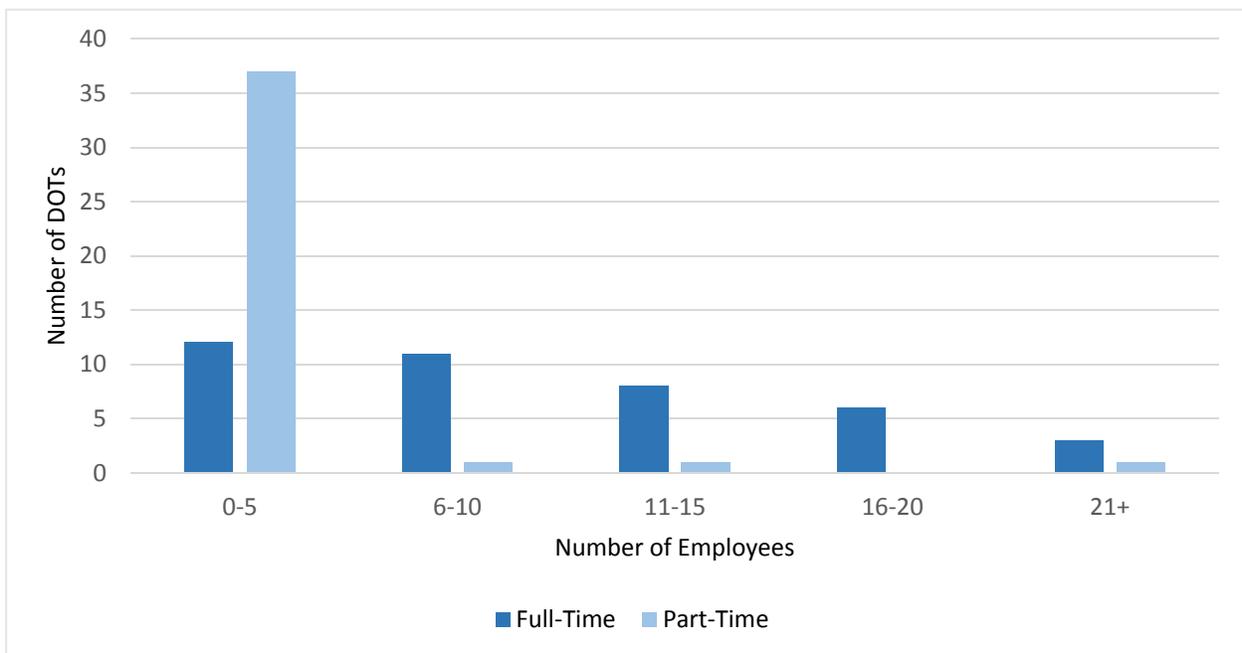


Figure 4-1. Number of Dedicated TMS Staff reported by the State DOTs

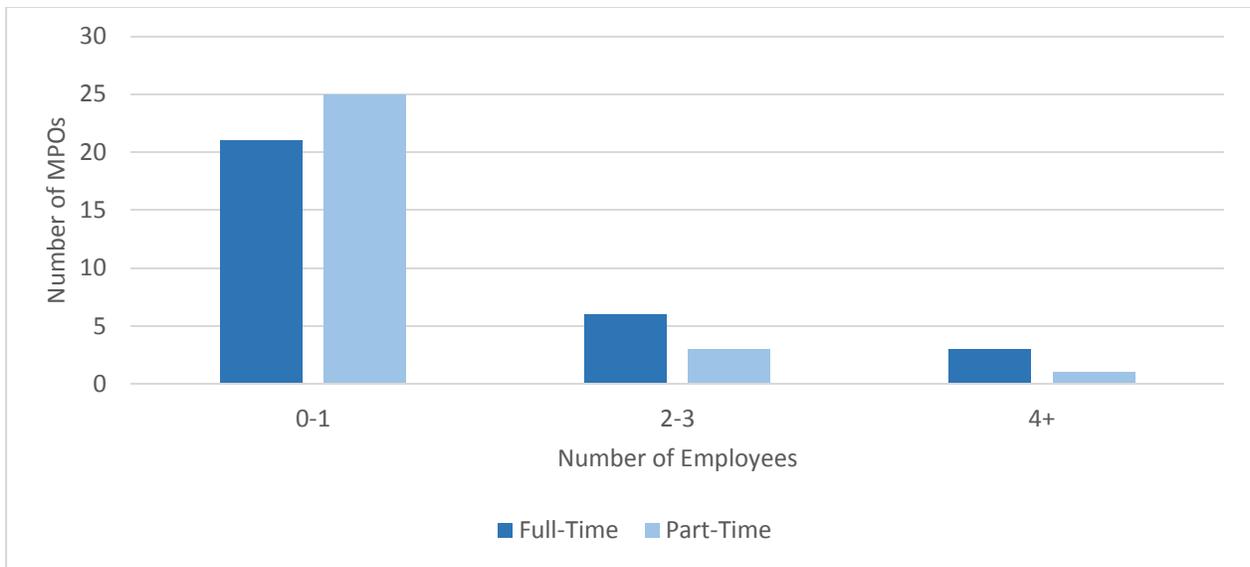


Figure 4-2. Distribution of Dedicated TMS Staff reported by the MPOs

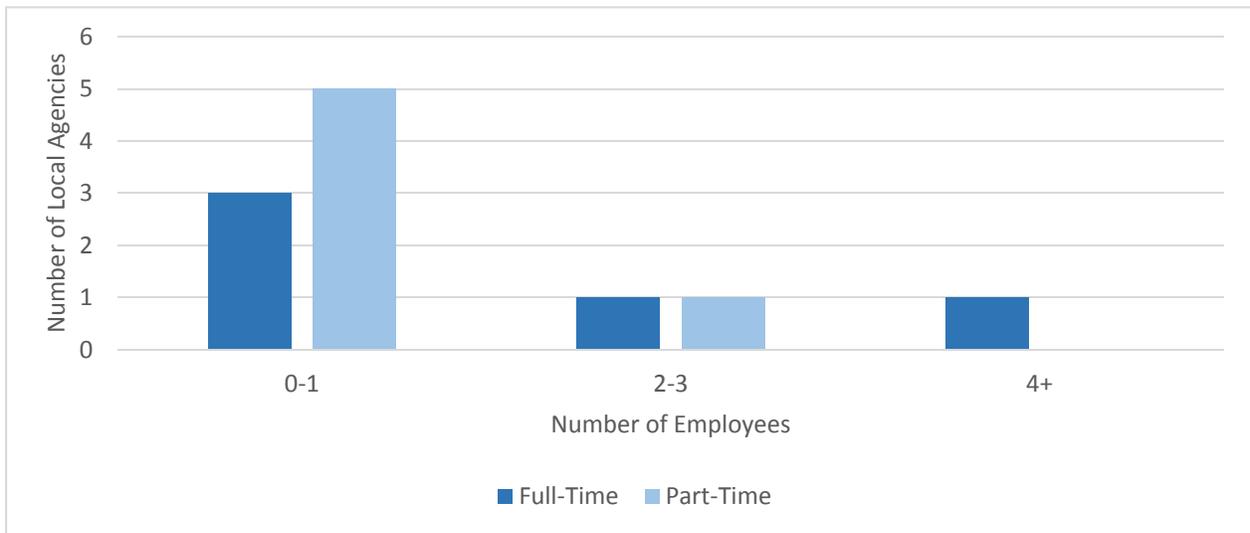


Figure 4-3. Number of Dedicated TMS Staff reported by the Local Agencies

In order to understand any possible correlation, the reported staffing levels of the agencies were further evaluated based on the in/outsourcing practices of the respondents, in conjunction with a cross-tabulation of selected TMS activities. The web assessment did not ask the agencies to specify their staffing levels for each category nor for all of the activities. Instead, it asked for the number of full-time and part-time staff dedicated solely to the TMS activities. The agencies’ full and part-time staff numbers were clustered and cross-tabulated with the averaged staff numbers with the in/outsourcing profile of the agencies for the specific TMS activities. It is important to note that the resourcing profile referred to here is not the “general resourcing profile” of all agency activities, but the resourcing profile for the in/outsourcing practice for each of the four TMS activity types under the Categories 1, 2, and 3. This information was collected under the Qualification Questions (*Question #8 - Please mark the level of insourcing/outsourcing for each of the TMS activities within the three main categories*). **Table 4-1** includes a tabulation of the average staff numbers based on the cross-tabulation of staff and in/outsourcing of selected activities.

Table 4-1. Overall Staffing Profiles of the Agencies by resourcing Profile for Select TMS Activities

Resourcing Practice	Activity Type							
	CCS Equipment or complete CCS site installation		Site Installations		Portable manual counts		Volume counts, classification counts, speed measurements	
	Average Number of Staff		Average Number of Staff		Average Number of Staff		Average Number of Staff	
	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time
Fully Outsourced	7.7	1.4	7.9	1.6	3.0	0.4	1.5	0.2
Mostly Outsourced	11.1	0.7	9.8	0.8	7.7	0.4	6.4	0.7
<i>Outsourced (combined)</i>	<i>18.8</i>	<i>2.1</i>	<i>17.7</i>	<i>2.4</i>	<i>10.7</i>	<i>0.8</i>	<i>7.9</i>	<i>0.9</i>
Mostly Insourced	7.4	2.0	14.3	1.4	11.1	2.3	9.0	1.2
Fully Insourced	11.4	3.5	7.8	3.8	8.7	3.0	7.6	3.1
<i>Insourced (combined)</i>	<i>18.8</i>	<i>5.5</i>	<i>22.1</i>	<i>5.2</i>	<i>19.8</i>	<i>5.3</i>	<i>16.6</i>	<i>4.3</i>

The charts included in *Figure 4-4* and *Figure 4-5* breaks down the information presented in *Table 4-1* in separate graphs showing the full-time and part-time staff distribution by selected TMS activity, respectively.

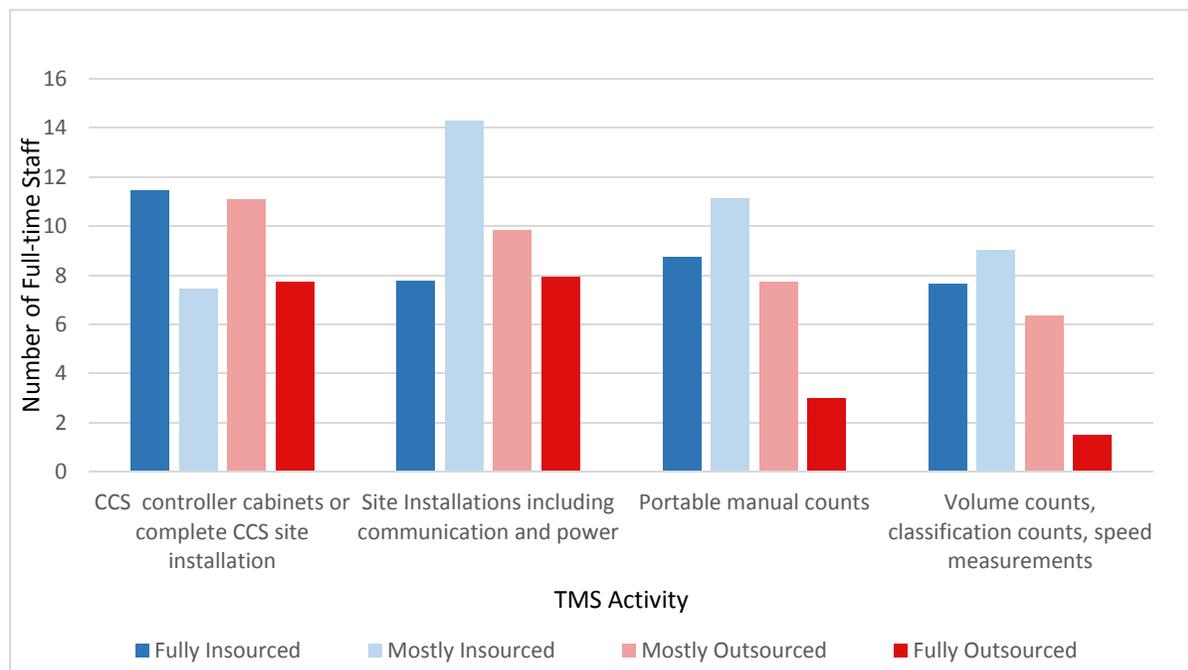


Figure 4-4. Average Number of Full-time Staff by Resourcing Profile for Select TMS Activities

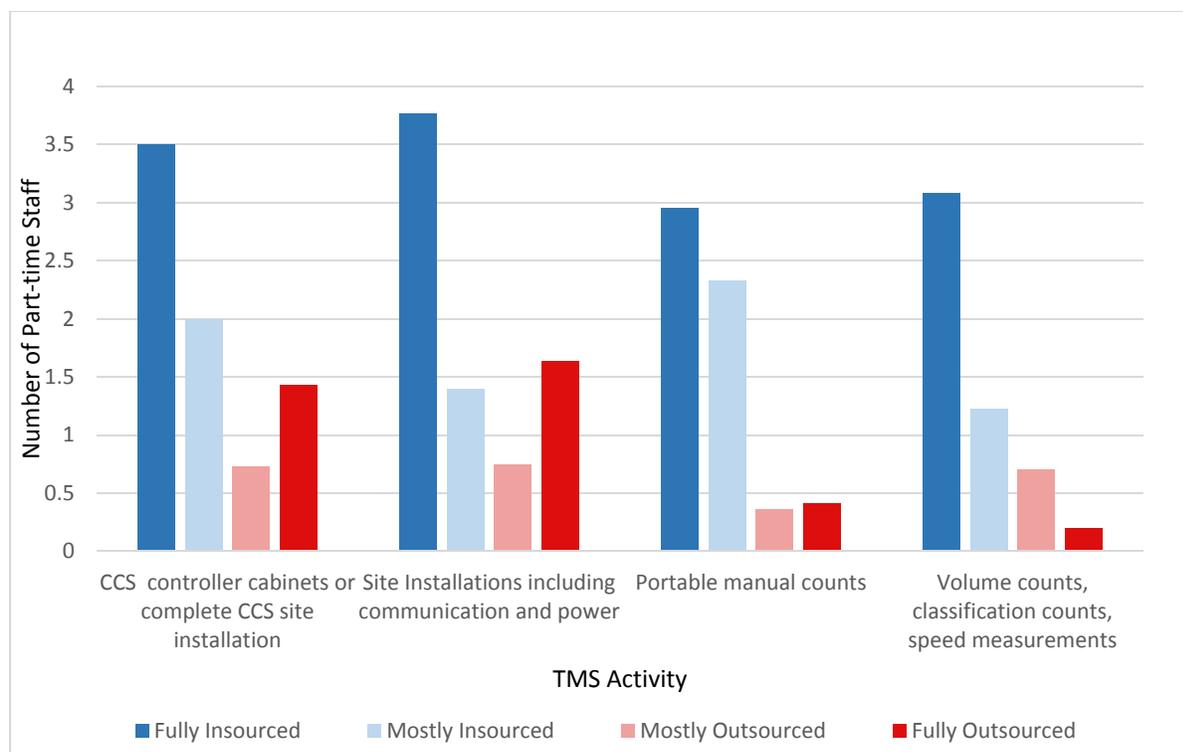


Figure 4-5. Average Number of Part-time Staff by Resourcing Profile for Select TMS Activities

The above information indicates that the full-time staff numbers of the agencies that outsource their traffic count activities are generally lower than the agencies that insource those activities. However, the data does not indicate if an agency initially experiencing a reduced full-time staff necessitates its decision to outsource or if the opposite is true and an agency’s decision to historically outsource additional staff has resulted in reduced full-time insourced staff levels. Such questions were later addressed during through interview questions to better understand possible associations and activity patterns.

Based on the responses of the majority of the agencies interviewed under the three categories, it was determined that 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.

Another observation confirming the association between the full- or part-time staffing levels and in/outourcing was that there was no discernable difference between the average number of full-time staff of the in- or outsourcing agencies under the equipment and CCS installation activities. When controlled for the centerline coverage and the TMS program scale, it is probable that the insourcing agencies would have to maintain a higher staff level than the outsourcing agencies. However, when the staffing needs of the outsourcing agencies under Category 1 activities (Equipment and Sensor Installation) was discussed during the interviews, the majority of outsourcing agencies indicated that they in fact maintain full- or part-time staff for inspection during installations of various equipment or CCS sites, and for associated maintenance operations after the equipment/CCS is placed in service. These variables likely account for the similarity shown by the numbers in *Figure 4-3* and *Figure 4-4*.

Based on the data presented in *Figure 4-4* and *Figure 4-5*, it can also be observed that the level of reported part-time staff is constantly higher for the agencies that fully insource their activities when compared to the agencies that outsource. Although not discussed during the interviews, this observation suggests that having part-time staff provides flexibility to the agencies and they can complete some of the activities in-house, where need be.

The details of the discussions regarding challenges, experiences, and lessons learned are summarized and included in the following sections where the evaluations under each category are presented.

4.2 Dedicated Vehicles for TMS Activities

The number of responding agencies that own vehicles exclusively for TMS activities is shown in *Table 4-2*. Most responding DOTs own vehicles exclusively for TMS activities, but most responding MPOs do not. The total number of vehicles that are assigned to the agency were not captured. The data shown in *Table 4-2* shows the number of vehicles used exclusively for the TMS program activities.

Table 4-2. Reported Agency Vehicle Ownership Exclusively for TMS Activities

	Yes	No
DOT	34	6
MPO	4	26
Local	3	3

4.3 Overall Resourcing Profiles by Agency Type, Category, and TMS Activity

Regarding Category 1 (Permanent Sensor and/or Equipment Installations) TMS activities, 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. The distribution of Category 1 TMS activities by agency type is depicted in *Figure 4-6*.

For 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. The distribution of Category 2 TMS activities by agency type is depicted in *Figure 4-7*.

For Category 3 (Other Contracting Methods), there was an even split among local agencies for fully/mostly insourcing and fully/mostly outsourcing TMS activities. Both state DOTs and MPOs tend to fully or mostly insourcing their Category 3 TMS activities. The distribution of Category 3 TMS activities by agency type is depicted in *Figure 4-8*.

The majority of the state DOTs, for all three categories, indicated that their in/outsourcing practices had been in effect for greater than 15 years with a large portion indicating the current practices had occurred for over 20 years. The MPOs and local agencies were more divided in the historical pattern of their in/outsourcing practices, with no clear trend exhibited. The distribution of historical in/outsourcing practices by category and agency type is depicted in *Figure 4-9*.

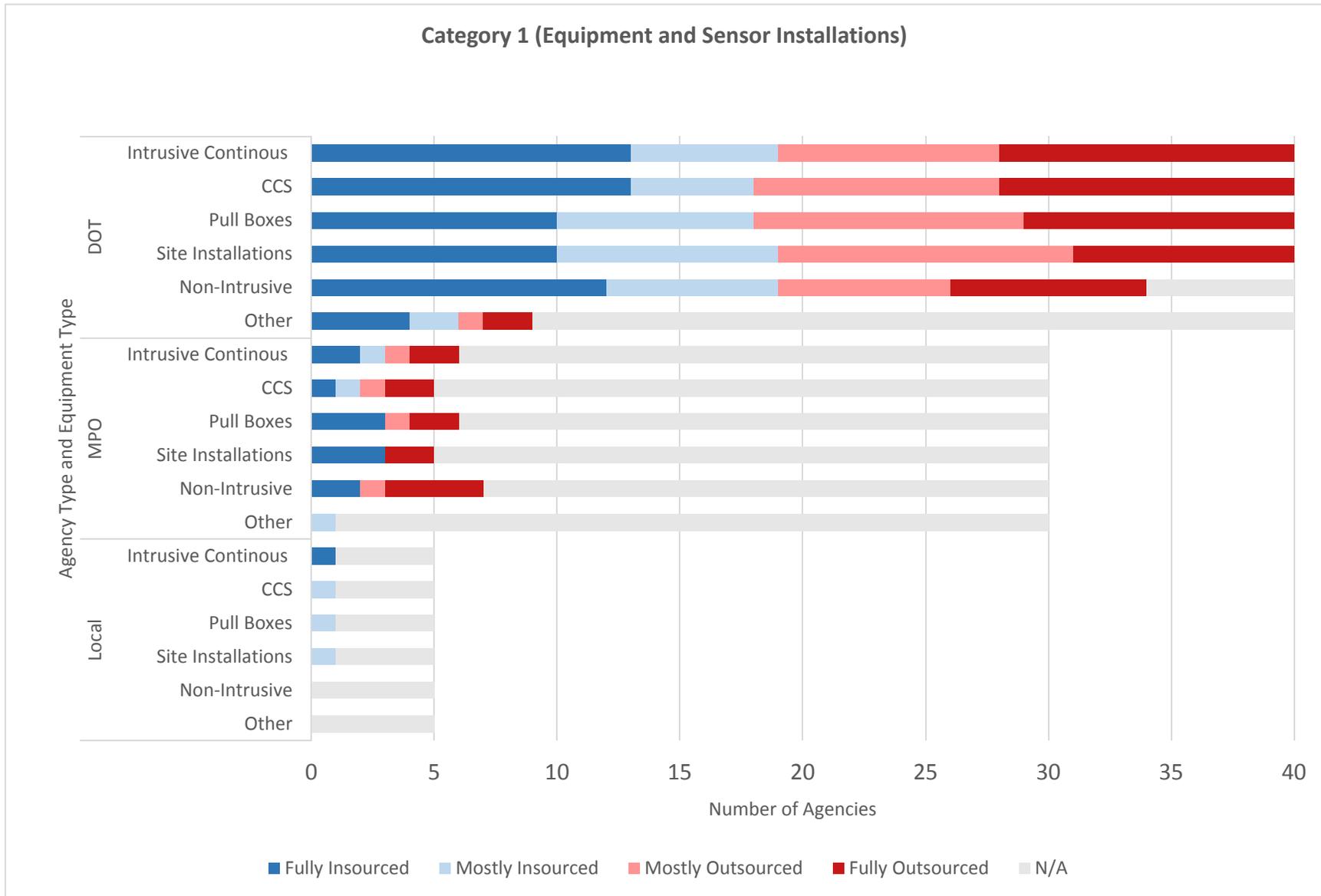


Figure 4-6. TMS Insourcing/Outsourcing Profile of Responding Agencies' Category 1 Activities

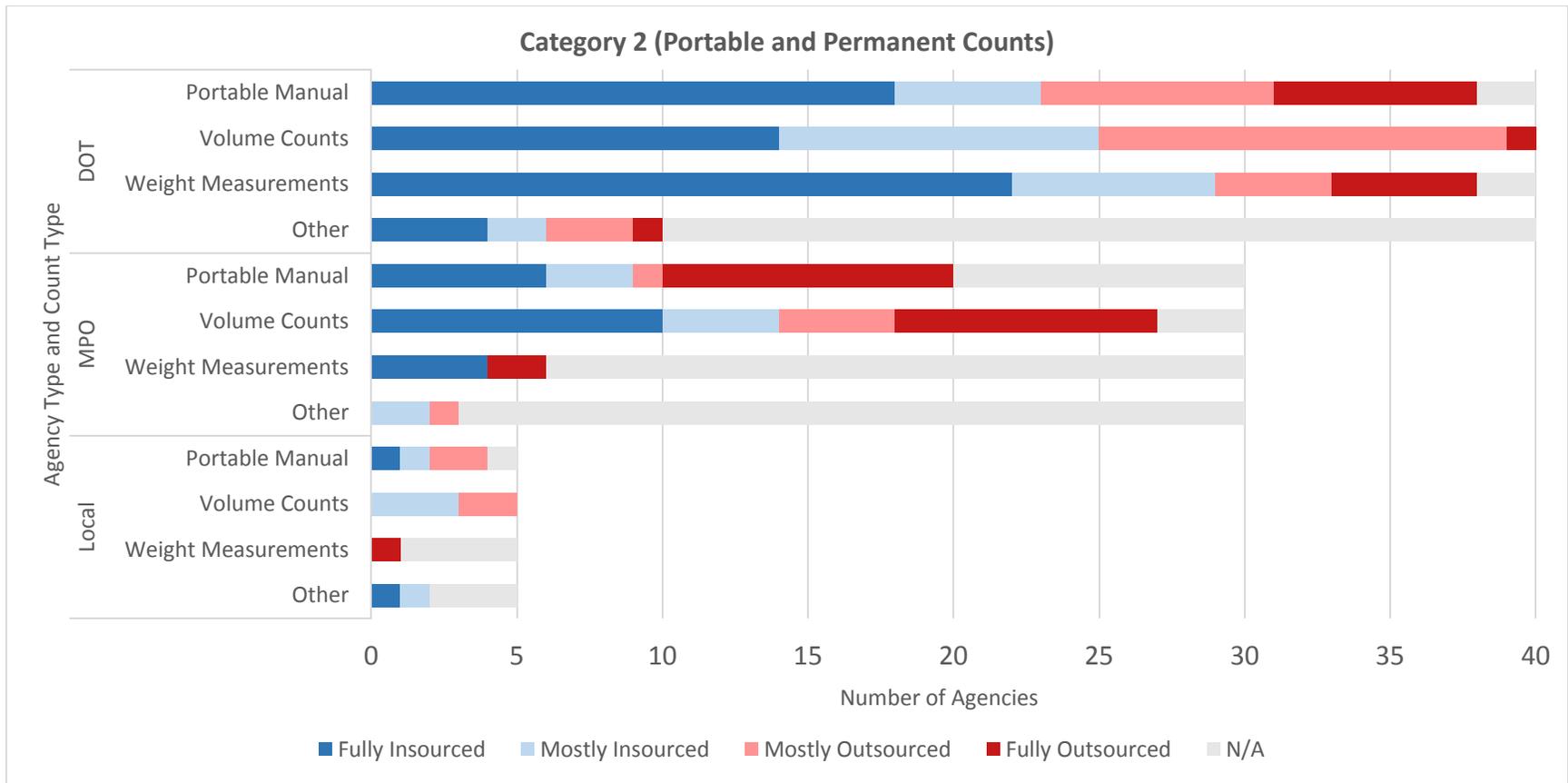


Figure 4-7. TMS Insourcing/Outsourcing Profile of Responding Agencies' Category 2 Activities

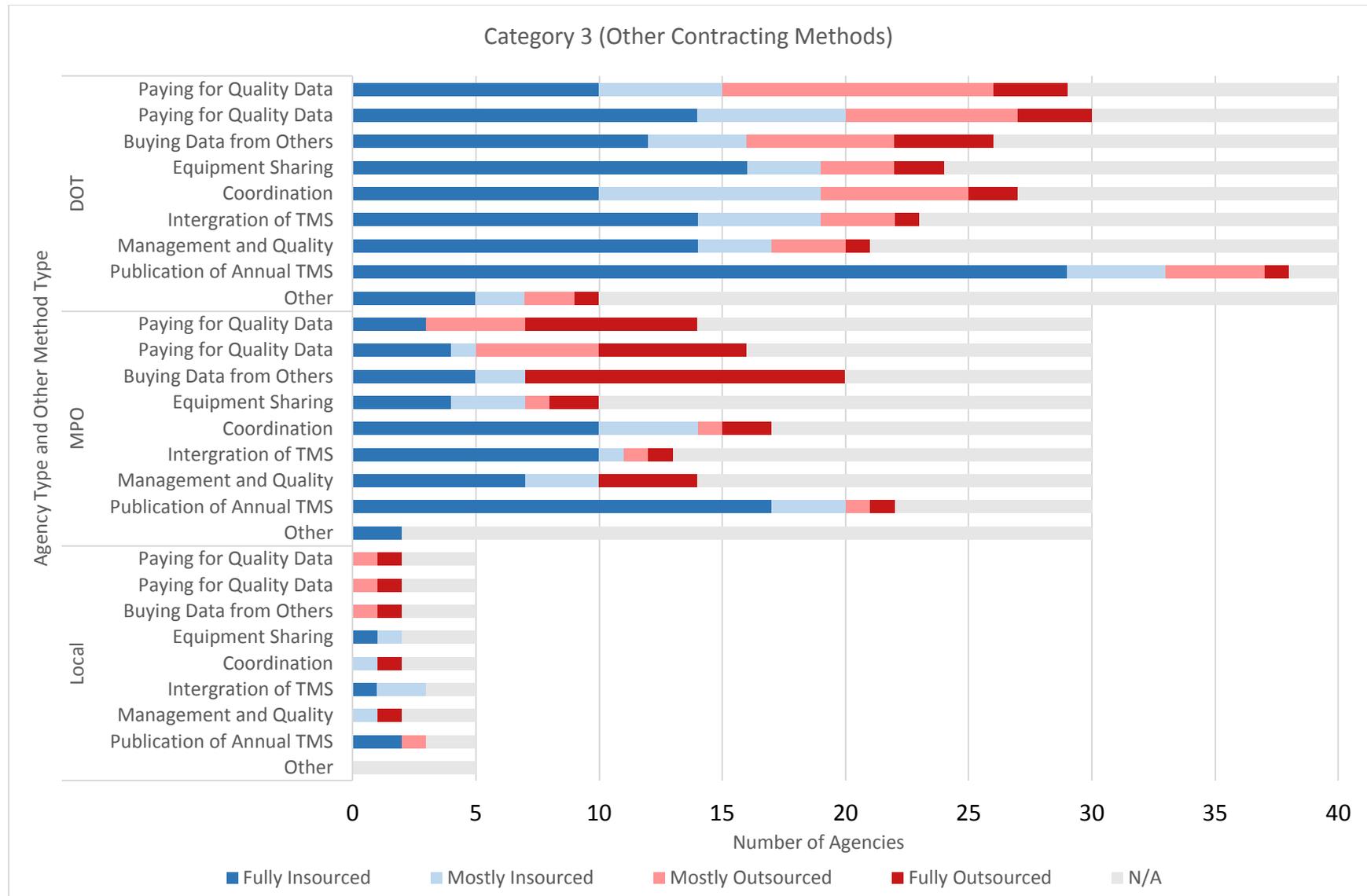


Figure 4-8. TMS Insourcing/Outsourcing Profile of Responding Agencies' Category 3 Activities

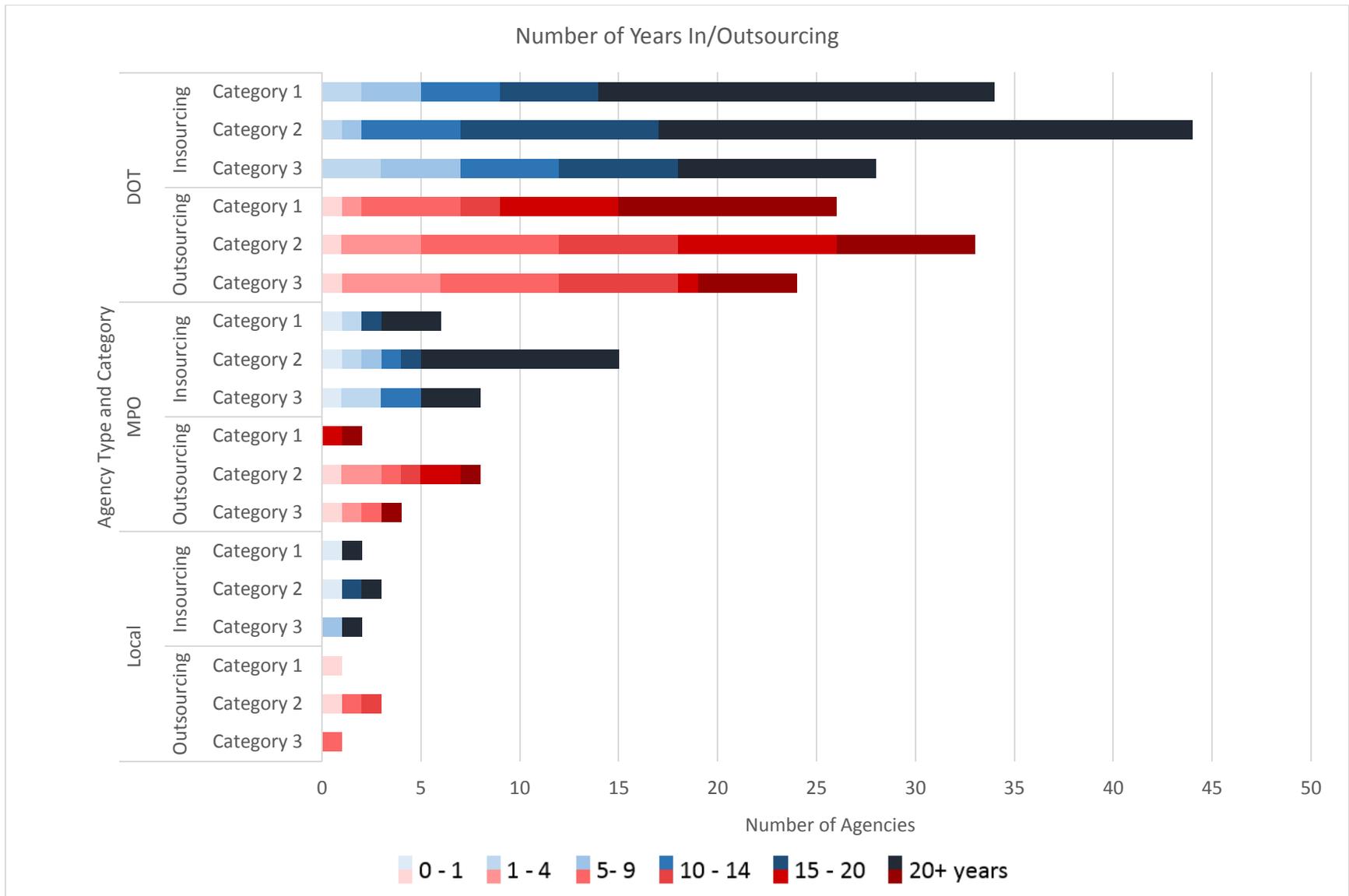


Figure 4-9. Number of Years Responding Agencies has been Insourcing/Outsourcing TMS Activities

4.4 Resourcing Profiles for TMS Activities by Agency Type

There are 15 activities (combined) under Category 1, 2, and 3. Based on the responses collected using the web assessment, the following *Table 4-3* and *Figure 4-10* show the breakdown of the resourcing practices for the combined activities by the agency type. Referring to *Table 4-3*, when the agency types and activities under the three categories are combined, it can be observed that the insourcing-to-outsourcing ratio is approximately 1.55.

Table 4-3. Resourcing Practices by Agency Type (three categories combined)

Resourcing Practice	Agency Type						Total	
	State DOT		MPO		Local Agency			
	Activities		Activities		Activities		Activities	
	Number	%	Number	%	Number	%	Number	%
Fully Outsourced	81	14.8%	69	32.4%	11	25.6%	161	20.0%
Mostly Outsourced	121	22.0%	23	10.8%	11	25.6%	155	19.3%
Mostly Insourced	103	18.8%	29	13.6%	13	30.2%	145	18.0%
Fully Insourced	244	44.4%	92	43.2%	8	18.6%	344	42.7%
Agency Type Total	549	100%	213	100%	43	100%	805	100%

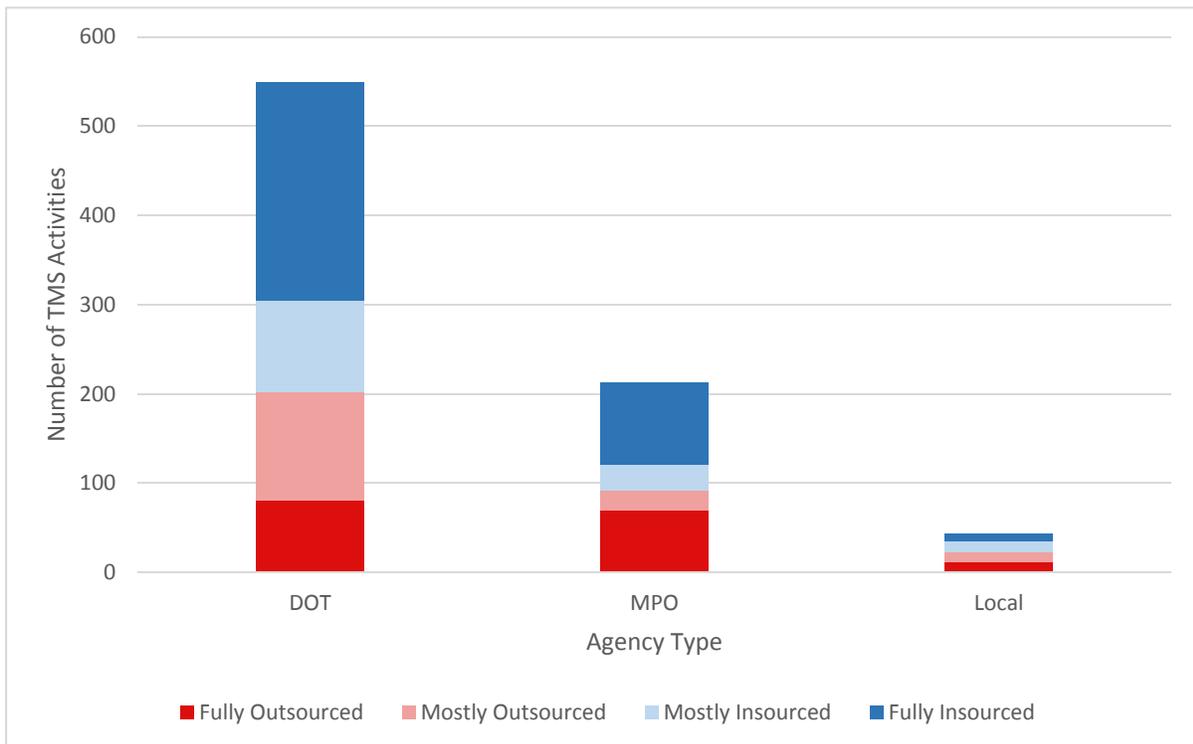


Figure 4-10. Resourcing Profile for Activities by Agency Type (all categories combined)

When the resourcing practices of mostly and fully insourcing agencies are combined, it can be observed that the state DOTs practice insourcing for approximately 63.2 percent of their traffic monitoring activities, MPOs practice approximately 56.8 percent, and local agencies approximately 48.8 percent. Fully insourced practices are observed to be 44.4, 43.2, and 18.6 percent for the state DOTs, MPOs, and local agencies, respectively. Fully outsourced practices by agency type is observed to be 14.8, 32.4, and 25.6 percent for the state DOTs, MPOs, and local agencies, respectively.

Because the required labor hours, efforts, and funding for each activity is different, the above percentages depicted in **Table 4-3** and **Figure 4-10** cannot be directly translated into a quantitative understanding of the in/outsourcing from a financial or a workforce perspective. However, it is noteworthy that the combined percentage of insourcing for all three types of agencies is approximately 60 percent, and the insourcing percentage of each appears to be somewhat consistent at 63.2, 56.8, and 48.8 percent regardless of the agency type. The chart in **Figure 4-11** depicts the percentage distribution of the same information provided in **Table 4-3** and **Figure 4-10**.

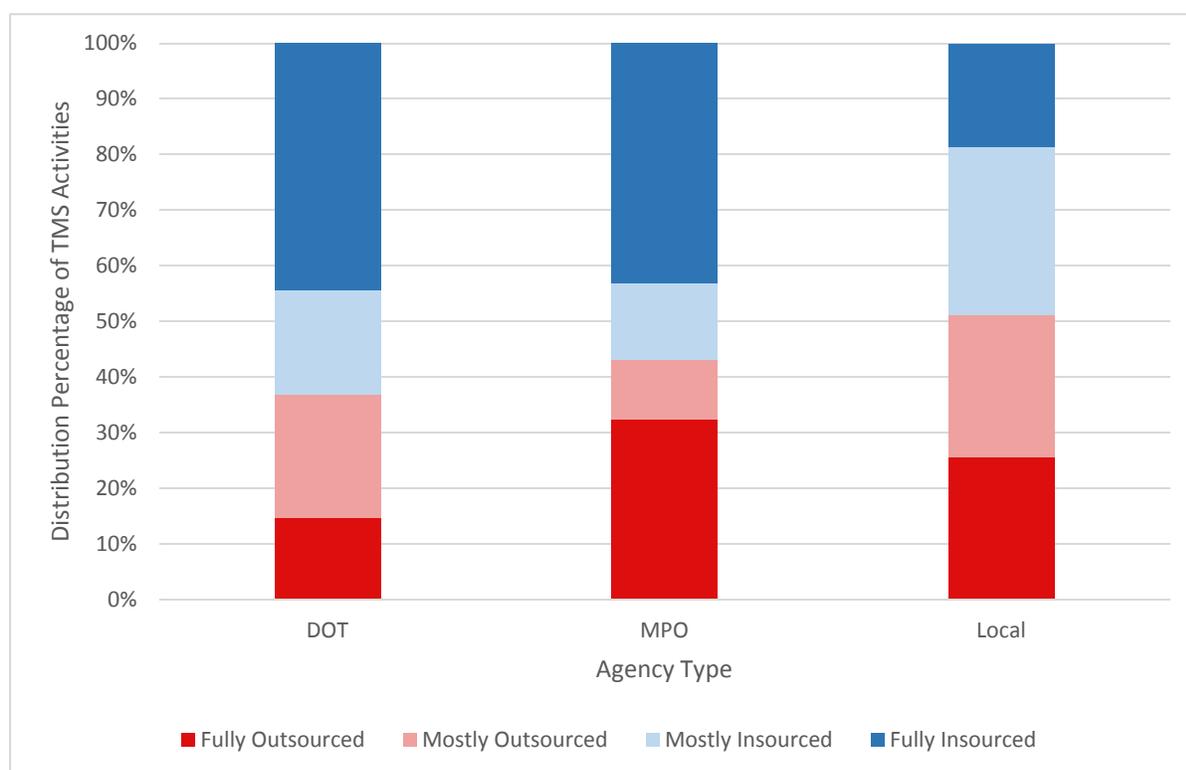


Figure 4-11. Distribution of Resourcing Profile for Activities by Agency Type

4.5 Quality Assurance and Quality Control (QA/QC) Process

The vast majority of DOTs indicated that they had a documented QA/QC process in place while no local agency indicated such. The term “documented” was defined as “routinely followed procedures that are reviewed and updated periodically.” The number of MPOs with documented QA/QC processes was nearly evenly split with those MPOs without a documented process. **Figure 4-12** provides the breakdown of documented QA/QC processes by agency type.

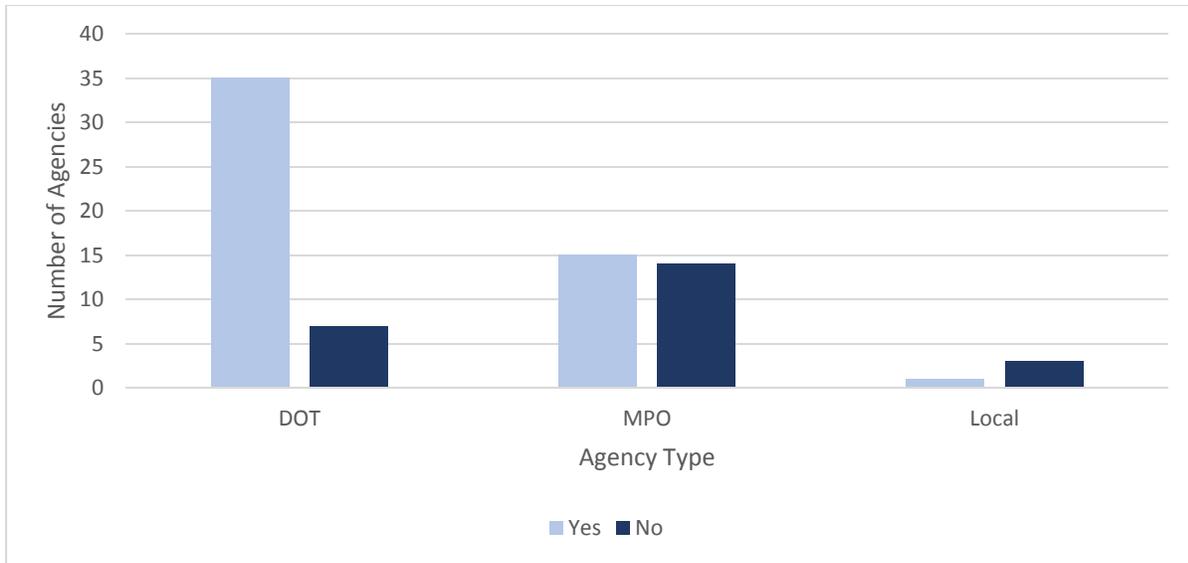


Figure 4-12. Presence of Documented QA/QC Process by Agency Type

During follow-up interview sessions, there was consensus among agencies that a documented QA/QC process is beneficial in maintaining consistency in data quality, passing on institutional knowledge (especially when staff members leave), and providing a checklist to ensure satisfactory contractor work, where QA/QC procedures also serve as an acceptance mechanism for contractor work and issuing payments. The following **Figure 4-13** shows the distribution of the availability of a documented QA/QC processes by agency type. 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. Larger agencies such as the state DOTs or MPOs of large metropolitan areas have documented and more formal procedures for their QA/QC process; however, interviews revealed that such “documentation” takes many forms to include internal QA/QC manuals, manufacturers or software vendors’ specifications, calibration and data quality manuals, and sections dealing with QA/QC procedures from contracting documents.

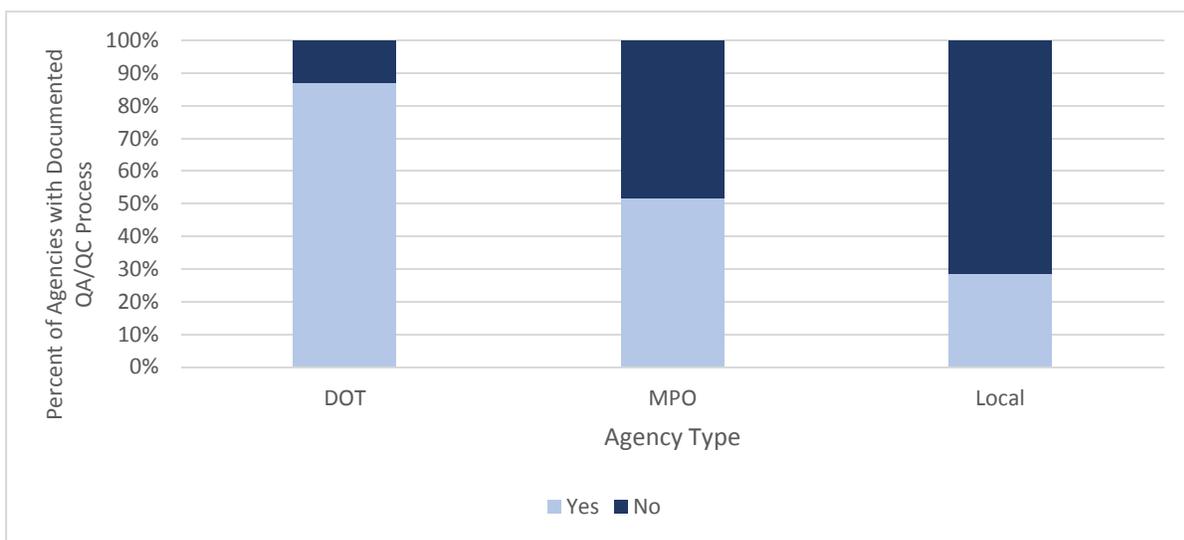


Figure 4-13. Distribution of Presence of Documented QA/QC Process

A further breakdown of the documented QA/QC processes by resourcing profile for select TMS activities such as CCS site installations and portable short-term counts, revealed that, there is no discernable variance between the insourcing (mostly and fully combined) and outsourcing (mostly and fully combined) practices. **Table 4-4** summarizes the breakdown of the documented QA/QC processes by resourcing practice and selected activity type. **Figure 4-14** and **Figure 4-15** depict this information in graphic format to show the distribution by activity and resourcing type in absolute and percentage formats, respectively.

Table 4-4. Documented Quality Control and Quality Assurance Process by resourcing Profile for Select Activities

Resourcing Practice	Activity Type							
	CCS Equipment or complete CCS site installation		Site Installations		Portable manual counts		Volume counts, classification counts, speed measurements	
	Yes	No	Yes	No	Yes	No	Yes	No
Fully Outsourced	11	3	8	3	13	4	6	4
Mostly Outsourced	11	0	12	0	9	2	16	4
<i>Outsourced (combined)</i>	<i>22</i>	<i>3</i>	<i>20</i>	<i>3</i>	<i>22</i>	<i>6</i>	<i>22</i>	<i>8</i>
Mostly Insourced	4	3	8	2	6	3	12	6
Fully Insourced	12	2	10	3	17	8	16	8
<i>Insourced (combined)</i>	<i>16</i>	<i>5</i>	<i>18</i>	<i>5</i>	<i>23</i>	<i>11</i>	<i>28</i>	<i>14</i>

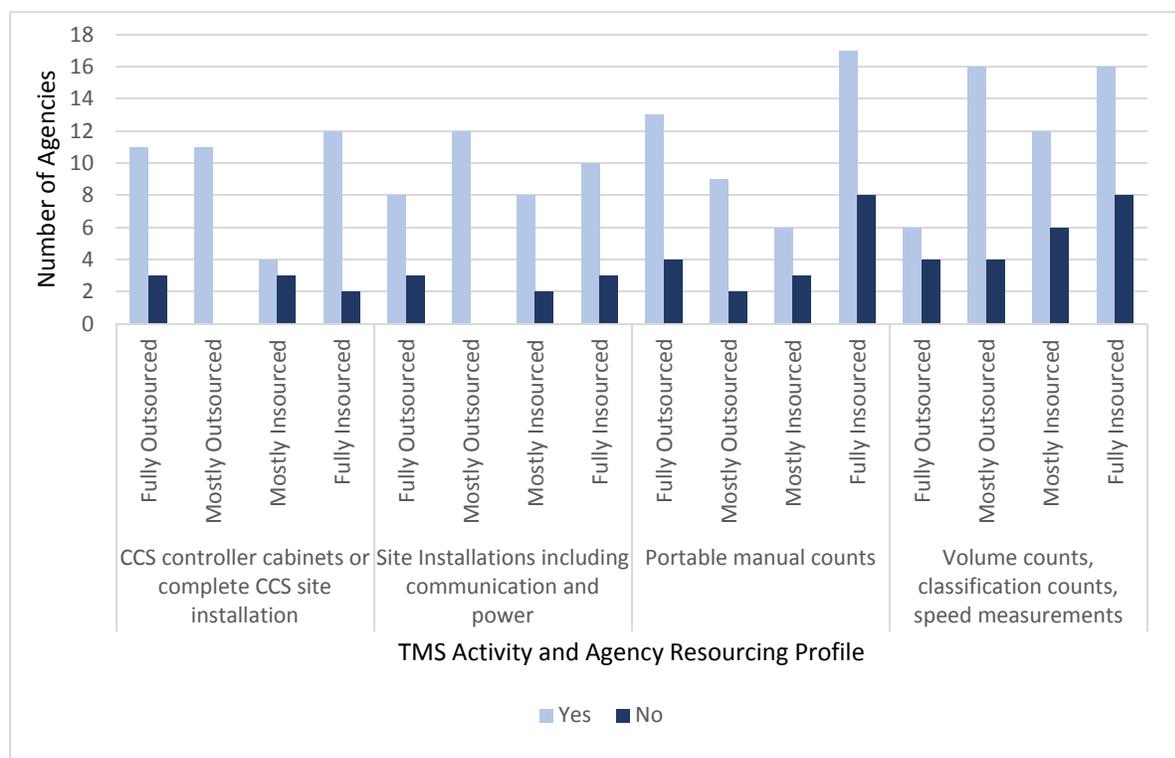


Figure 4-14. Documented Quality Control and Quality Assurance Process by Resourcing Profile for Select TMS Activities

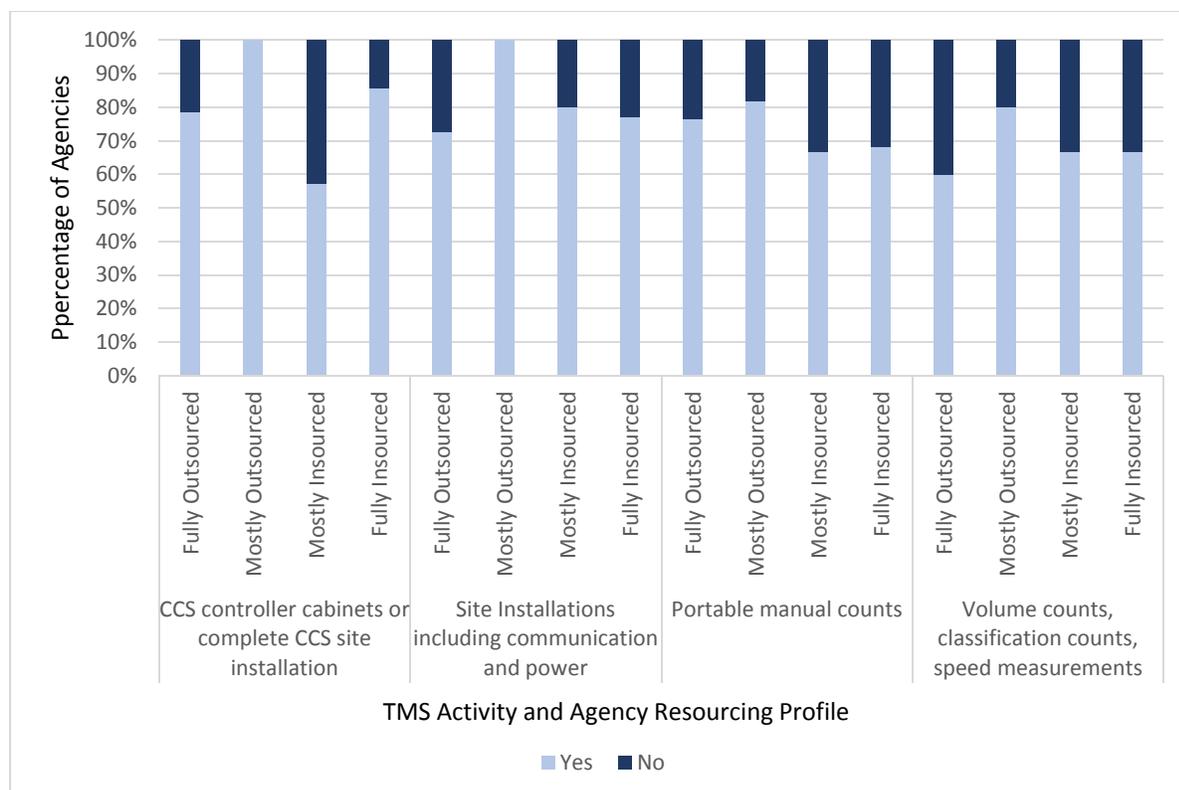


Figure 4-15. Distribution of the Documented Quality Control and Quality Assurance Process by Resourcing Profile for Select TMS Activities

According to the collected data, the distribution of the presence of QA/QC documentation procedures among the insourcing and outsourcing agencies is almost dichotomous, regardless of the agency type. It should also be noted that the documentation procedures are agency-specific and the level and content of the documentation varied greatly among responding agencies. There were a few instances where the local agency or the MPO QA/QC process was similar or based on the state DOT process where the agency or the MPO is located. However, those instances were noted to be cases of informal adaptation of or reference to the state DOT processes.

4.6 QA/QC of Outsourced Traffic Counts

As a related subject to the QA/QC processes, the agencies were also asked if they have written policies or specifications in the contracts for requiring recounts (i.e., what are the thresholds for accepting/rejecting counts, how many recounts are allowed for the same location, what is the timeframe for a recount, etc.). Based on the collected 23 responses, 60.9 percent of the agencies indicated that they have a written policy and 34.8 percent indicated that they do not. One agency indicated that they were not sure about their recount policy. Based on the responses to a follow-up question about the types of recounts, 60.0 percent of the recounts were identified as classification counts, 32.0 percent as volume counts, and four percent as speed and intersection turning movement counts. 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.

4.7 Decision-making Process

Agencies were asked about their practices for documenting decision-making processes. The term “documented” was defined as “routinely followed procedures that are reviewed and updated periodically.” The term “decision-making process” was defined as “a formal evaluation process such as benefit-cost analysis, cost comparison spreadsheet (without considering the benefits), agency-specific cost or resource efficiency evaluation spreadsheet or software, or any type of advantage/disadvantage evaluation methodology to provide justification for the agency’s insourcing or outsourcing decisions”. Agencies were also asked to describe their process briefly, as well as the reasons for such evaluations.

As presented previously in **Figure 4-9**, the majority of DOTs, for all three categories, indicated that their in/outsourcing practices had been in effect for greater than 15 years with a large portion indicating the current practices had occurred for over 20 years. 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. **Figure 4-16** provides the breakdown of documented decision-making processes by agency type.

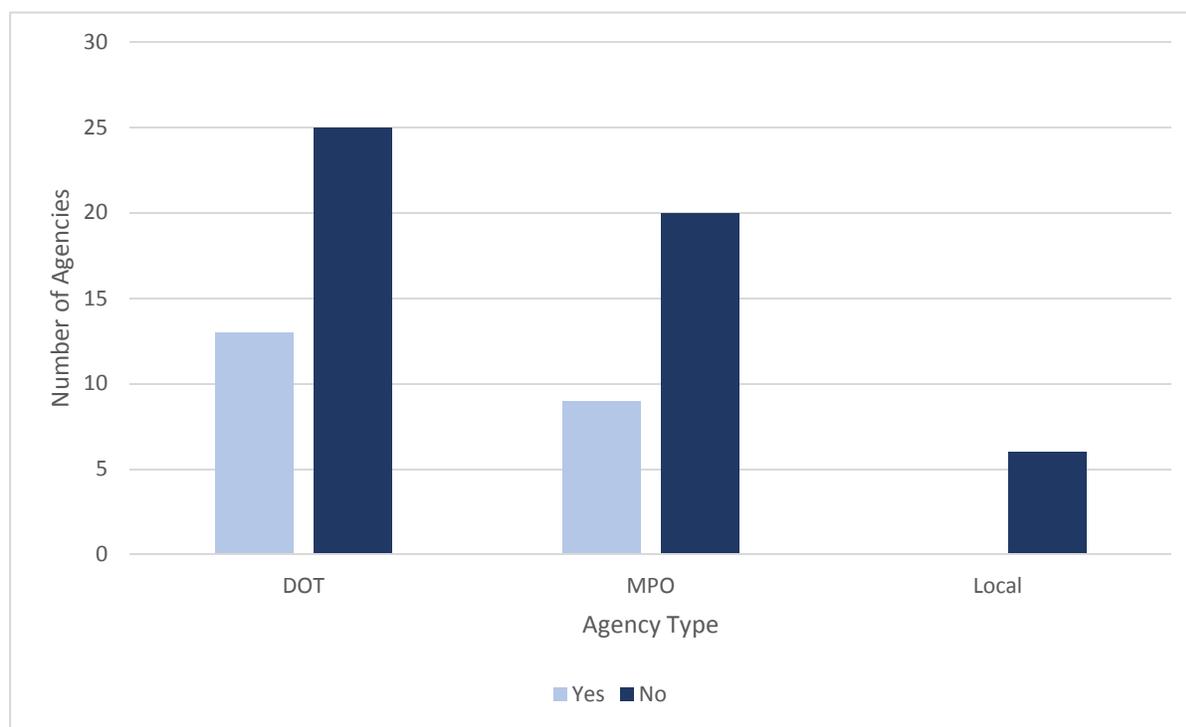


Figure 4-16. Availability of Documented Decision-Making Process for TMS Activities by Agency Type

The responses from agencies regarding their decision-making processes were further evaluated for possible relationships between key TMS activities and agencies’ documentation procedures for decision-making. *Table 4-5* summarizes the agency responses by resourcing practice and activity type.

Table 4-5. Documented Decision-making Process by Resourcing Profile for Select TMS Activities)

Resourcing Practice	Activity Type							
	CCS Equipment or complete CCS site installation		Site Installations		Portable manual counts		Volume counts, classification counts, speed measurements	
	Yes	No	Yes	No	Yes	No	Yes	No
Fully Outsourced	6	7	3	7	9	8	5	5
Mostly Outsourced	2	9	5	7	4	6	6	13
<i>Outsourced (combined)</i>	8	16	8	14	13	14	11	18
Mostly Insourced	2	5	4	6	1	8	5	13
Fully Insourced	4	9	2	10	6	18	5	18
<i>Insourced (combined)</i>	6	14	6	16	7	26	10	31

The data in *Table 4-5* shows that regardless of agency type, outsourcing agencies appear to have higher number of documented decision-making processes for portable manual counts when compared to other TMS activities. Outsourcing agencies also have a higher number of document decision-making processes for portable manual counts when compared to insourcing agencies for the same activity. Approximately 48 percent of the outsourcing agencies indicated that they have a documented process for their decisions regarding portable counts, and only 21 percent of the insourcing agencies verified that they have documentation for the decisions for the same activity. 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. The variance between the resourcing type and decision-making documentation in equipment installation is not as great as count activities. When the equipment and CCS installation activities are combined, 34.8 percent of the outsourcing and 28.6 percent of the insourcing agencies indicated that they have a documented process.

The charts in *Figure 4-17* and *Figure 4-18* illustrate the distribution of the decision-making documentation among the selected activities by the resourcing practice of the agencies. Based on this information provided in *Table 4-5*, agencies, regardless of type, tend to document their decision-making processes for portable and permanent counts when they outsource those activities to contractors. Additionally, regardless of type, agencies have less documentation for their decision-making processes when they insource or outsource their equipment and CCS installations. Finally, the data shows that agencies also have less documentation for their decision-making process when they chose to insource both their count and equipment installation activities.

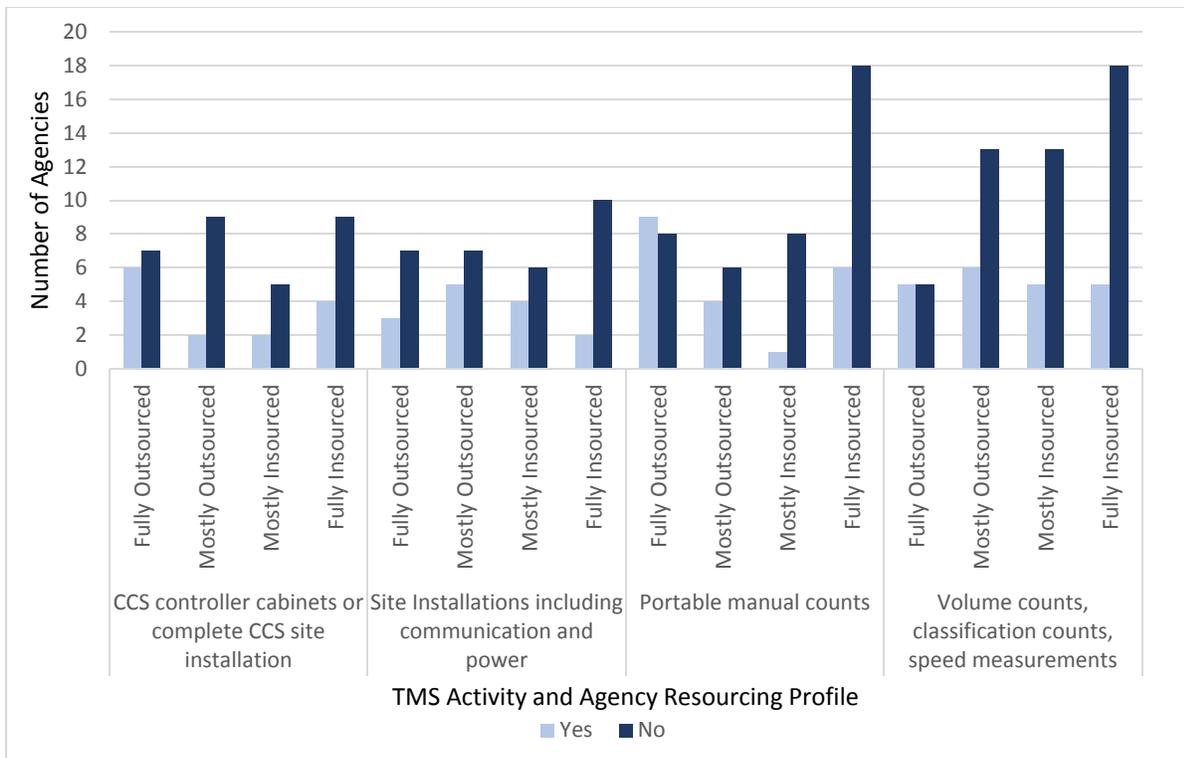


Figure 4-17. Documented Decision-making Process by Resourcing Profile for Select TMS Activities

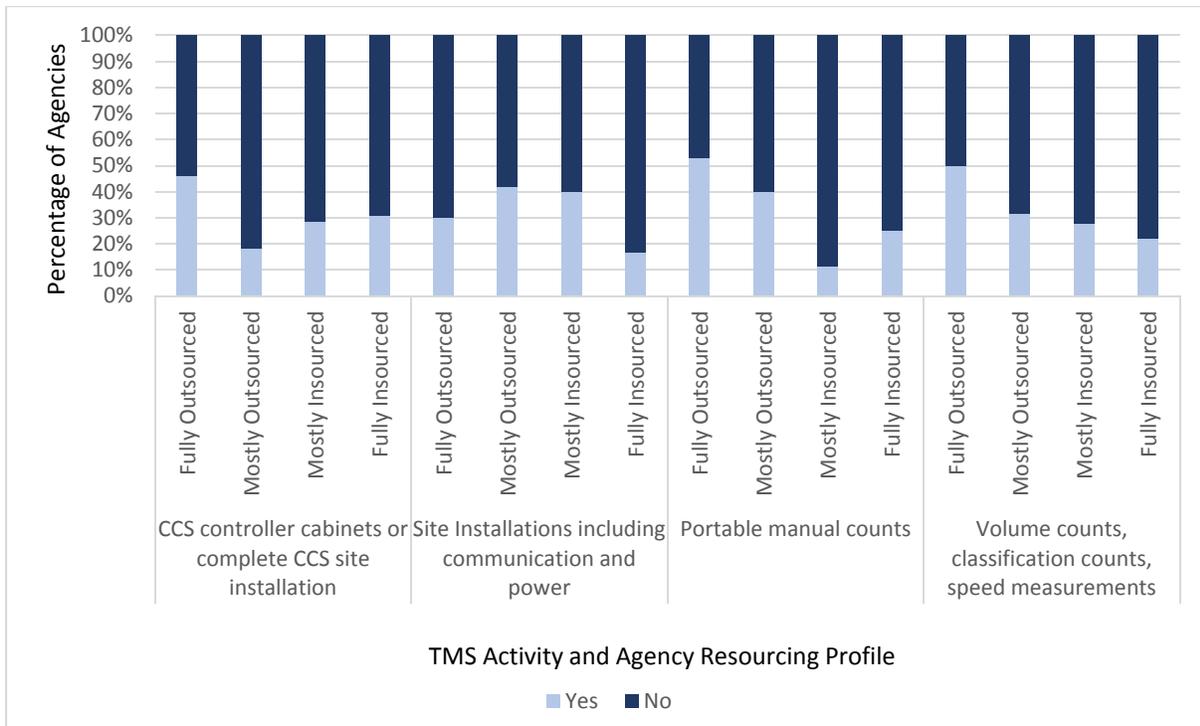


Figure 4-18. Distribution of the Documented Decision-making Process by Resourcing Profile for Select TMS Activities

4.8 Decision-makers for Agencies’ In/Outsourcing Practices

The agencies were asked to identify the titles of their agencies’ employees involved in the decision-making process for the TMS activities. **Figure 4-19** shows the summary of responses for the decision-makers involved in the resourcing decisions under Category 1, 2, and 3 activities.

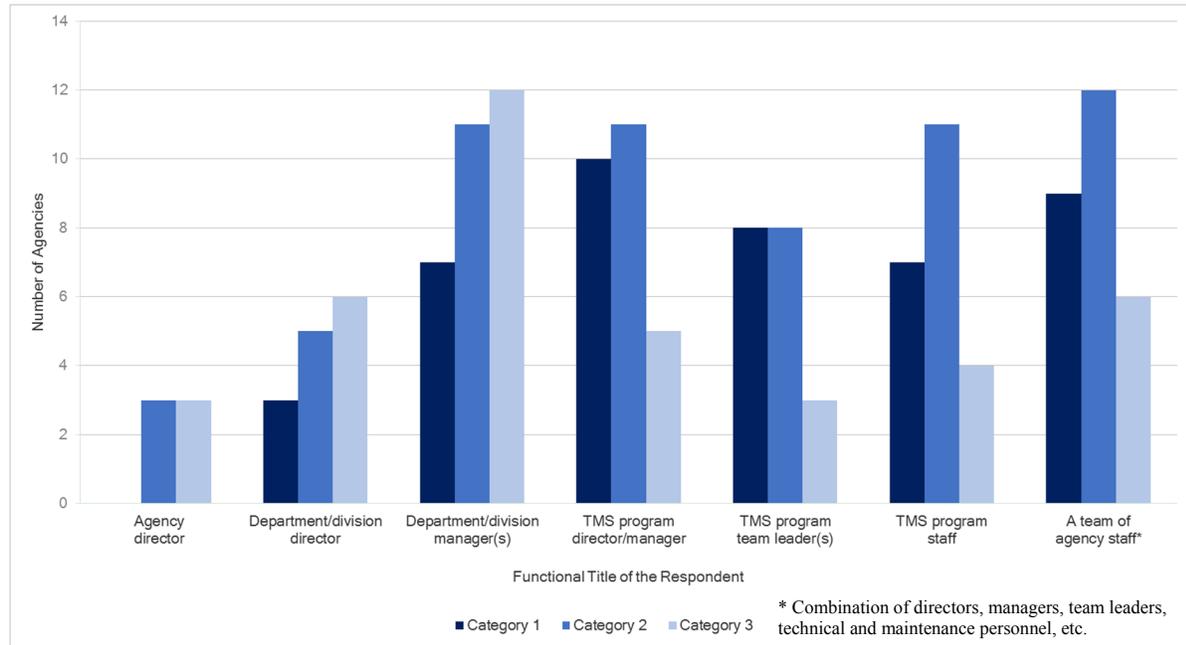


Figure 4-19. Distribution of Decision-makers among the Three TMS Activity Categories

As presented in **Figure 4-19**, the agencies were asked to identify decision-makers for the different types of TMS activities, but the decision-makers were intentionally not grouped in the question. During the evaluation of the responses, the researchers grouped the decision-makers into three categories as follows:

- Group 1: Agency, Department, or Division Director/Manager (single decision-maker who is not directly involved in the TMS program)
- Group 2: TMS Program Director/Manager, Team Leader, or staff (single decision-maker who is directly involved in the TMS program)
- Group 3: Team of agency staff (the composition of the “team” is expected to be different for each agency, but a combination of directors, managers, team leaders, technical and maintenance personnel was provided in the question)

Table 4-6 shows a summary of the decision-maker distribution, based on the responses of 27 agencies that answered this question.

Table 4-6. Distribution of Responses Identifying Decision-making Groups

Decision-maker Group	TMS Activity Category							
	CATEGORY 1		CATEGORY 2		CATEGORY 3		COMBINED	
	Number of Responses	%	Number of Responses	%	Number of Responses	%	Number of Responses	%
Group 1	10	22.7%	19	31.1%	21	53.8%	50	34.7%
Group 2	25	56.8%	30	49.2%	12	30.8%	67	46.5%
Group 3	9	20.5%	12	19.7%	6	15.4%	27	18.8%

When all the categories are combined, the agencies identified Group 2 decision-makers as the predominant group by 46.5 percent, followed by Group 1 by 34.7 percent, and Group 3 by 18.8 percent. This is a particularly interesting finding because during the interviews with the selected agencies, the majority of the interviewees either indicated or implied that decisions regarding in/outsourcing are made by executive and/or upper management who were not necessarily directly involved in the TMS program activities. Based on the summary in *Table 4-6*, the majority of the decision-makers under Category 1 and 2 TMS activities fall under Group 2--the group that includes the TMS Program Director/Manager, Team Leader, or staff members. When the Categories 1, 2, and 3 are combined, Group 2 decision-makers are the predominant group by 46.5 percent. This was found to be not aligned with the agencies' responses during the interviews. The details of the interview discussions are included in the following sections.

4.9 Annual Budget Allocations for TMS Activities

4.9.1 Most Recent Year Budget and Spending

The agencies were asked about their current annual budgets for the different TMS activities under the three categories. **Figure 4-20** shows the distribution of the annual budgets (in six ranges) by agency type and by category, based on the responses from 21 agencies (14 state DOTs, six MPOs, and one local agency).

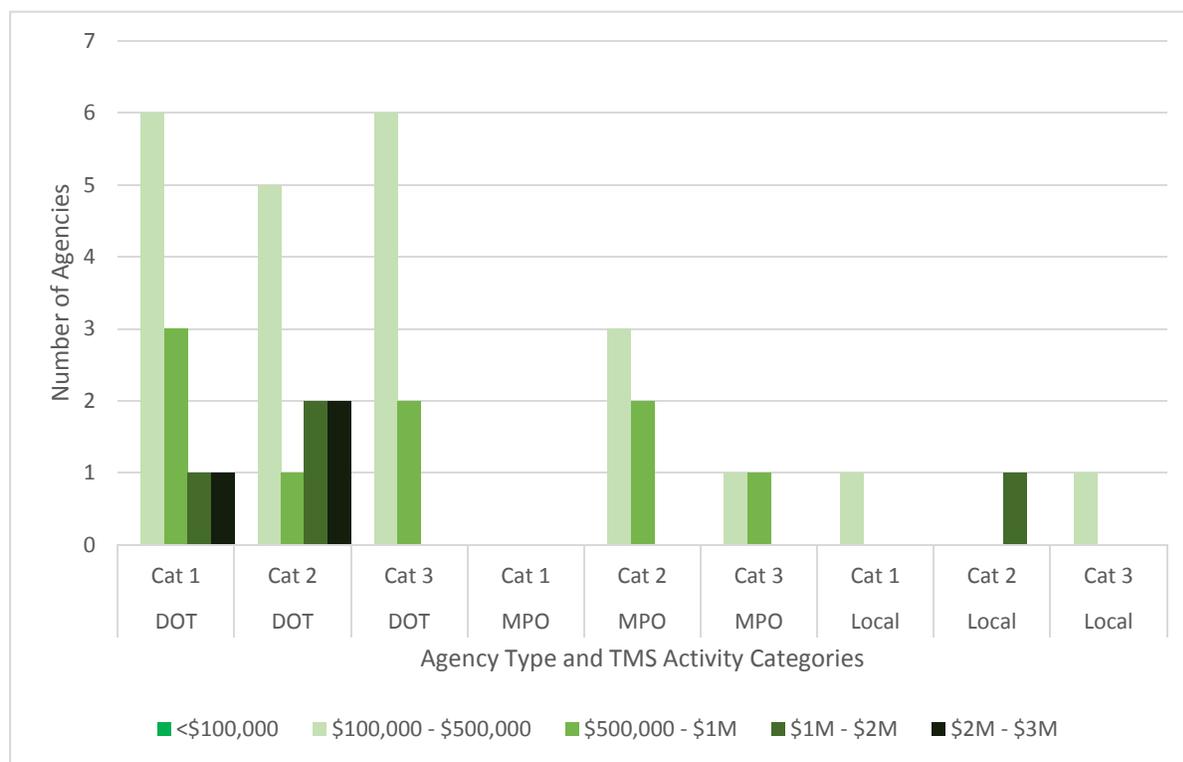


Figure 4-20. Current Agency Budgets by Agency Type and by TMS Activity Category

It was expected that state DOTs have more funding budgeted for their TMS activities under Category 1, 2, and 3, and the reported budget figures from this study confirm this expectation. 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 immediate observation is that the reported annual budgets are predominantly in the \$100,000-\$500,000 range for the state DOTs.

Another question was asked as a follow-on for the annual budgets to understand the comparison of the spent funds versus the budgeted funds. The agencies were asked about their annual contract ceiling and actual spending on the installation and data collection contracts. Based on the 16 agencies' responses to this question, 94 percent reported that they spend 100 percent of the allocated annual budget on the data collection or equipment installation tasks. Therefore, it was not found necessary to try to establish any association between the resourcing profile of the agencies and their spending pattern.

4.9.2 Most-recent Six-year Budget Trends

The agencies were also asked about their budgets and spending for the most recent six-year period (2010-2015) for each of the TMS activities under the three categories. The six-year annual budgets of all agencies were aggregated and averaged together by the agencies' resourcing profile for each activity type. In summary, evaluation of the most recent six-year budgets also confirmed the finding of the most-recent year annual budgets, where DOTs have more funding budgeted for their TMS activities under Category 1, 2, and 3. However, since the analyses include a six-year span, there are some trends observed where the budgets for certain activities and by specific resourcing method were following increasing or decreasing trends. These detailed analyses and associated charts showing the six-year trends are included in Appendix D.

4.10 Evaluation of TMS Activity Unit Costs

Agencies were asked to provide the approximate unit cost for each type of installation or count, based on contracts completed during the most recent six years. The installation or count types for the unit cost question were slightly different from the typical TMS activities that have been used in this report. The following is a list of the count or installation types for this question:

- Continuous count station (CCS) installation (per lane)
- Non-intrusive sensor installation (e.g., radar, passive infrared, ultrasonic, acoustic, CCTV)
- Permanent weigh-in-motion (WIM) station installation (per lane)
- Portable WIM station installation
- Short-period portable classification count (48 hours)
- Short-period portable classification count (7 days)
- Short-period portable volume count (48 hours)
- Short-period portable volume count (7 days)
- Short-period portable classification/volume/speed count (48 hours)
- Short-period portable classification/volume/speed count (7 days)
- Intersection turning movement count (12 or 13 hours)
- Intersection turning movement count (peak period)
- Special counts (12-hour vehicle occupancy)
- Special counts (peak period HOV lane) – there were no responses indicating the unit cost for this activity; therefore, this activity was not included in the analyses
- Special counts (12-hour manual classification or CCS validation)

Nine state DOTs and one MPO provided a response to this question and they included the range of the unit costs for different types of data collection and equipment installation activities. The responding state DOTs resourcing profiles and the unit cost data that they provided were cross-tabulated. While cross-tabulating, it was important to create a classification matrix where the activities listed above were matched with the activities that were included in the agencies' resourcing profiles for the TMS activities under the three categories. *Table 4-7* shows the matching of the activities under the TMS categories and unit cost methods.

Table 4-7. Cross-tabulation Matrix for Matching the Activities Under the Unit Cost and TMS Categories

Unit Cost-based Activities														
Agency Type	Continuous count station (CCS) installation	Sensor installation	Weigh-in-motion (WIM) station installation		Short-period portable classification count		Short-period portable volume count		Short-period portable classification/volume/speed count		Intersection turning movement count		Special counts	Special counts (12-hour manual classification or CCS validation)
	per lane	Non-intrusive	Permanent (per lane)	Portable	48 hours	7 days	48 hours	7 days	48 hours	7 days	12/13 hours	peak period	12-hour vehicle occupancy	N/A
DOT	1A	1E	1D	1D	2A	2A	2A	2A	2A	2A	2A	2A	2B	2B
TMS Category-based Activities														
1. Category 1 - Permanent Sensor and/or Equipment Installation A. Intrusive Continuous Counting Station (CCS) sensors D. Site installations including communication and power (including portable power sources) E. Non-intrusive sensor installation (e.g., radar, passive infrared, ultrasonic, acoustic, CCTV, SmartSensors™)							2. Category 2 - Portable and Permanent Counts A. Portable manual counts (video, in-person, or electro-mechanical) B. Volume counts, classification counts, speed measurements (intrusive and non-intrusive)							

After the matching was completed, the researchers cross-tabulated the agencies’ responses to the insourcing and outsourcing practices for the activities under the three categories and the responses for the unit cost of certain data collection and/or equipment installation activities. This process matched the unit costs with the resourcing practice of an agency. **Table 4-8** summarizes the results showing the unit costs by resourcing type. There was one MPO that provided a response to the unit cost question, but the information provided was for only one activity. The values entered by the MPO were therefore excluded from the following analyses. Due to the limited number of responses (i.e., data points), researchers were cautious as to how to represent the cross-tabulated data and not to draw definitive conclusions. The primary reason for this analysis is to understand if an association can be established using a limited data points rather than establishing a definitive connection. There are many variables that could contribute to the differences in unit prices other than agencies’ resourcing practices. These factors may include the geographic location of the agency, an agency’s relationship with its contractors, volume discounts by contractors/vendors, the cost of re-counts, and the actual costs considered for the insourcing of activities such as mileage, equipment wear and tear, materials, inspection costs, etc. For this reason, the following analyses are evaluated from a limited data point perspective. A separate effort is recommended to collect and analyze additional data in the future to provide more accurate conclusions.

Table 4-8. Unit Costs as reported by the Agencies and Based on an Average of Lower and Upper Bound of Each Cost Category (Note: evaluations in Table 4-8 are based on limited data points and a more comprehensive data collection effort is recommended in the future for a more accurate evaluation)

Agency Type	Continuous count station (CCS) installation	Sensor installation	Weigh-in-motion (WIM) station installation		Short-period portable classification count		Short-period portable volume count		Short-period portable classification/volume/speed count		Intersection turning movement count		Special counts	Special counts (12-hour manual classification)
	per lane	Non-intrusive	Permanent (per lane)	Portable	48 hours	7 days	48 hours	7 days	48 hours	7 days	12/13 hours	peak period	12-hour vehicle occupancy	N/A
DOT	--		--	--	\$300 - \$399	--	\$200 - \$299	--	\$300 - \$399	--	\$1,000 - \$1,099	\$300 - \$399	--	\$1,000 - \$1,099
DOT	--		\$12,000 - \$12,999	--	\$1,000 - \$1,099	\$1,700 - \$1,799	\$1,000 - \$1,099	\$1,500 - \$1,599	--	\$1,700 - \$1,799	--	--	--	--
DOT	--		--	--	\$200 - \$299	--	--	--	--	--	--	--	--	--
DOT	--	\$1,900 - \$1,999	--	--	--	--	--	--	--	--	--	--	--	--
DOT	\$8,000 - \$8,999	\$25,000 - \$25,999	\$50,000 - \$59,999	--	\$400 - \$499	--	\$100 - \$199	--	\$400 - \$499	--	--	--	--	--
DOT	\$10,000 - \$10,999	\$1,000 - \$1,099	\$30,000 - \$39,999	\$1,000 - \$1,099	\$200 - \$299	\$200 - \$299	\$200 - \$299	\$500 - \$599	\$500 - \$599	\$500 - \$599	--	--	--	--
DOT	--	--	--	--	\$400 - \$499	\$500 - \$599	\$400 - \$499	\$500 - \$599	\$400 - \$499	\$500 - \$599	\$700 - \$799	--	\$700 - \$799	\$700 - \$799
DOT	\$1,000 - \$1,099	\$4,000 - \$4,099	\$1,500 - \$1,599	\$1,700 - \$1,799	\$2,000 - \$2,099	\$2,000 - \$2,099	\$2,000 - \$2,099	\$2,000 - \$2,099	<\$100	<\$100	\$1,000 - \$1,099	\$1,000 - \$1,099	--	--
DOT	\$8,000 - \$8,999	--	\$8,000 - \$8,999	--	--	\$1,300 - \$1,399	--	\$1,300 - \$1,399	--	\$1,300 - \$1,399	--	--	--	--
Avg. (combined)	\$7,138	\$8,038	\$22,510	\$1,450	\$693	\$1,190	\$700	\$1,210	\$370	\$850	\$950	\$700	\$750	\$900
Avg. (outsourcing)	\$6,683	\$4,050	\$22,510	\$1,450	\$975	\$1,900	\$875	\$1,800	\$300	\$925	\$1,050	\$700	--	\$1,050
Avg. (insourcing)	\$8,500	\$9,500	--	--	\$316	\$716	\$350	\$816	\$500	\$816	\$750	--	\$750	\$750
KEY														
Fully Outsourced			Mostly Outsourced			Mostly Insourced			Fully Insourced			No Answer Provided		

As presented in **Table 4-8**, the reported unit costs for the activities that involve equipment, CCS, or WIM installations did not present a great diversity of resourcing profiles; therefore, it was difficult to identify a discernable pattern in the data or use the averages for meaningful conclusions. Activities, such as ‘intersection turning movement’ or ‘special counts’ such as vehicle-occupancy also failed to have sufficient data points to present an observable pattern.

Five to seven agencies provided unit costs for the following categories:

- Short-period portable classification counts (48 hours and 7 days)
- Short-period portable volume counts (48 hours and 7 days)
- Short-period portable classification/volume/speed counts (48 hours and 7 days)

Even though the data is limited, the answers represented a variety of resourcing profiles ranging from fully insourced to fully outsourced. The following consistent unit price patterns for the aforementioned three activities were observed:

- *Short-period portable classification counts* - For the 48-hour short-period portable classification counts, there was a significant difference observed in the unit prices. The average unit price for this activity type was calculated as \$975 for the outsourcing and \$316 for the insourcing agencies. For the 7-day short-period portable classification counts, the average unit price was calculated as \$1,900 for the outsourcing and \$716 for the insourcing agencies.
- *Short-period portable volume counts* - For the 48-hour short-period portable volume counts, there was a significant difference observed in the unit prices. The average unit price for this activity type was calculated as \$875 for the outsourcing and \$350 for the insourcing agencies. For the 7-day short-period portable volume counts, the average unit price was calculated as \$1,800 for the outsourcing and \$816 for the insourcing agencies.
- *Short-period portable classification/volume/speed counts* – Some agencies use this type of vehicle classification and speed cross-tabulations. For the 48-hour short-period portable volume counts, there was a significant difference observed in the unit prices. The average unit price for this activity type was calculated as \$300 for the outsourcing and \$500 for the insourcing agencies. The observed reason for the average outsourcing unit price being lower than the average unit price for insourced activity can be linked to the limitation of available data points. Under the 48-hour data collection within this TMS activity, outsourcing has three data points as “\$300-\$399,” “\$400-\$499,” and “<\$100,” where the average computes to \$300. For the 7-day short-period portable volume counts, the average unit price was calculated as \$925 for the outsourcing and \$816 for the insourcing agencies.

During the interviews, the majority of the agencies that outsource their data collection activities indicated that their contracting methods are more cost-efficient due to a number of reasons to include reduced unit costs, reduced number of full- and part-time staff, and flexibility for suspending the activities. On the contrary, the agencies who insource such activities indicated that their costs are lower when compared to outsourcing. The details of the interviews are summarized in the following sections, but the analyses summarized in **Table 4-8** using limited data points does not necessarily agree with the unit costs being lower for the outsourcing agencies. As cautioned previously, above evaluations are based on limited data points. A more comprehensive data collection effort is recommended in the future for a more accurate evaluation.

5.0 INTERVIEW PROCESS AND EVALUATIONS

5.1 Development of Agency Profiles

After the web questionnaire was closed, the responses were evaluated and several matrices were developed to select the agencies that would be of interest based on their contracting profiles, as well as several other criteria, such as:

- Geographic area of the agency’s coverage
- Centerline coverage under the agency’s jurisdiction
- Number of CCS in their TMS
- Number of staff involved in the TMS activities
- Number of sensor/equipment installation and different types of counts per annum
- Presence of a data quality management plan or documentation
- Agency’s resourcing practice for different TMS activities
- Timeline of agency’s resourcing profile:
 - practicing the current resourcing for a long time
 - recently changed resource practices
 - considering change to current resource practices

5.1.1 Agency Selection

The selection criteria involved evaluation of the agency profile matrices in order to achieve “diversity” in agencies’ in/outsourcing proportions, staffing numbers, geographic diversity, and documentation of procedures. The following steps explain the sequential process that was used in agency selection for conducting interviews:

- (1) A database was created listing all agencies that responded to the questionnaire and their responses to the *qualification questions*.
- (2) The agencies were then classified into the eight regions published by the U.S. Bureau of Economic Analysis (BEA)¹⁰ for geographic diversity. At a minimum, two agencies were chosen from each of the eight BEA regions.
- (3) The agencies in each geographic region were “ranked” based on the centerline coverage (from FHWA HPMS), presence of data quality management plan, resourcing profile, and timeline of resourcing profile. The number of staff was also considered, but the weight of staff number was not as determinant as the other factors. *Appendix E* details the available and provided data for agencies responding to the online assessment used in the ranking of state DOTs, MPOs, and local agencies.
- (4) The following are the factors that were used in the selection:
 - Geographic region
 - Centerline coverage
 - Number of CCS

¹⁰ <http://bea.gov/regional/docs/regions.cfm>

- Number of WIM stations
 - Number of short-duration traffic counts collected annually
 - Consultant contracts for your agency's TMS data collection activities
 - Number of full-time staff assigned to TMS activities
 - Number of part-time staff assigned to TMS activities
 - Number of vehicles designated exclusively for TMS activities
 - Years of insourcing
 - Years of outsourcing
 - Presence of a documented quality control and quality assurance process
 - Presence of a documented decision-making process for insourcing or outsourcing TMS activities
- (5) The list of potential state DOTs, MPOs, and local agencies to be interviewed was compared to the desired number of agencies that were selected. The number of agencies that were selected for interview was previously referenced in *Table 2-1*. Based on the criteria used for the agency profiles, the matrices shown in *Table 5-1* and *Table 5-2* were used in order to align the selection with the research objectives.

Assessment of Insourcing/Outsourcing Practices for Traffic Monitoring Data Collection
 Final Report – (April 2016)

Table 5-1. Profiles of the selected Agencies under each TMS Activity Category

Category	Item Number	Agency	State	Geographic Region	Centerline Coverage	Number of CCS	Number of WIM Stations	Number of short-duration traffic counts collected annually	Consultant contracts for your agency's TMS data collection activities	Number of full-time staff assigned to TMS activities	Number of part-time staff assigned to TMS activities	Own vehicles designated exclusively for TMS activities	Years Insourcing	Years Outsourcing	Do you have a documented quality control and quality assurance process?	Do you have a documented decision-making process for in/outsourcing of your TMS activities?
1	1	Arkansas SHTD	AR	Southeast	16414	66	40	9500	Yes	2	0	No	> 20	> 20	Yes	Yes
	2	Michigan DOT	MI	Great Lakes	9654	123	60	4000	No	9	1	Yes	> 20	> 20	No	No
	3	Minnesota DOT	MN	Plains	11856	90	20	7000	No	11	12	Yes		> 20	No	No
	4	Montana DOT	MT	Rocky Mountains	11003	103	37	3200	No	16	3	Yes	> 20	15 - 20	Yes	No
	5	New Mexico DOT	NM	Southwest	11965	113	19	2760	No	11	0	Yes		15 - 20	No	No
	6	Pennsylvania DOT	PA	Midwest	39792	101	17	10000	Yes	10	0	Yes		> 20	Yes	Yes
	7	South Carolina DOT	SC	Southeast	41409	155	3	12000	Yes	11	0	Yes	> 20		Yes	No
	8	Wisconsin DOT	WI	Great Lakes	11764	300	13	5000	Yes	3	1	Yes	15 - 20	< 1	Yes	Yes
	9	Merrimack Valley Planning Commission	MA	New England	N/A	0	0	110	No	1	0	No	> 20		Yes	No
	10	Northeastern Indiana Regional Coordinating Council	IN	Plains	N/A	8	0	1100	No	3	1	Yes	> 20	> 20	Yes	No
	11	City of Seattle DOT	WA	Far West	N/A	10	0	2000	Yes	4	1	Yes	> 20		No	No
2	12	California DOT	CA	Far West	15080	2371	144	337	No	30	0	Yes	> 20	> 20	Yes	No
	13	Connecticut DOT	CT	New England	3722	40	20	4000	No	12	0	Yes	> 20		Yes	No
	14	Maryland DOT	MD	Midwest	5166	87	1	3300	Yes	6	3	Yes	15 - 20	15 - 20	Yes	Yes
	15	Missouri DOT	MO	Plains	33845	175	18	5000	No	20	0	Yes	> 20		Yes	Yes
	16	New Jersey DOT	NJ	Midwest	2323	40	80	1600	Yes	2	1	Yes		15 - 20	Yes	No
	17	Ohio DOT	OH	Great Lakes	19256	197	30	7200	Yes	10	0	Yes	> 20	5-9	Yes	No
	18	Tennessee DOT	TN	Southeast	13879	62	0	12318	Yes	3	0	Yes	15 - 20		Yes	Yes
	19	Virginia DOT	VA	Southeast	58272	700	10	19500	Yes	13	0	Yes	15 - 20		Yes	No
	20	Central Massachusetts Regional Planning Commission	MA	New England	N/A	0	0	200	No	2	2	No	> 20		No	No
	21	Kern Council of Governments	CA	Far East	N/A	0	0	2000	Yes	1	0	No		5-9	Yes	Yes
	22	Maricopa Association of Governments	AZ	Southwest	N/A	309	20	2000	Yes	1	1	No	> 20	> 20	Yes	Yes
	23	Thurston County Public Works	WA	Far East	N/A	0	0	100	Yes	1	0	No	> 20	5-9	No	No
3	24	Alaska DOTPF	AK	Far West	5606	54	5	1000	Yes	2	0	No	15 - 20	> 20	Yes	Yes
	25	Indiana DOT	IN	Great Lakes	10982	84	65	50	No	8	0	No			Yes	Yes
	26	Nebraska DOR	NE	Plains	9949	65	0	4600	No	16	2	Yes			Yes	No
	27	Idaho Transportation Department	ID	Rocky Mountains	4979	250	25	2500	No	8	2	Yes	15 - 20		No	No
	28	Delaware Valley Regional Planning Commission	PA	Mid East	N/A	12	0	3000	No	10	0	Yes			Yes	No
	29	Southeast Michigan Council of Governments	MI	Great Lakes	N/A	0	0	6500	Yes	1	0	No	1-4	1-4	Yes	Yes
	30	Southwestern Pennsylvania Commission	PA	Mid East	N/A	0	0	500	No	4	4	No	10-14	5-9	Yes	No
	31	City of Charlotte DOT	NC	Southeast	N/A	0	0	700	No	3	1	Yes	> 20	> 20	No	No

The following is a breakdown of statistics of the selected state DOTs, MPOs, and local agencies:

State DOTs:

- The average full-time staff of selected agencies is 10.3 and the average part-time staff is 1.2. The minimum non-zero full-time staff is two (New Jersey and Alaska) and the maximum full-time staff is 30 (California).
- Fourteen of the selected agencies have a quality management program while four do not have such programs.
- Of the in/outsourcing options within each agency's chosen category, 45 were reported as fully or mostly insourced while 42 were reported as fully or mostly outsourced.
- When asked for the years of experience with the insourcing and outsourcing, one agency reported as less than one year, one as 5-9 years, nine as 15-20 years, and 11 agencies reported as more than 20 years.

MPOs:

- The average full-time staff of selected agencies is 2.9 and the average part-time staff is 1.0. The minimum non-zero full-time staff is one and the maximum full-time staff is 10 (Delaware Valley).
- Seven of the selected agencies have a quality management program while one does not have such a program.
- Of the insourcing and outsourcing options within each agency's chosen category, 19 were reported as fully or mostly insourced, while 15 were reported as either fully or mostly outsourced.
- When asked for the years of experience with the insourcing and outsourcing, two agencies reported as 1-4 years, two as 5-9 years, one as 10-14 years, and six as more than 20 years.

Local Agencies:

- The average full-time staff of chosen agencies is 2.7 and the average part-time staff is 0.7. The minimum non-zero full-time staff is one (Thurston County) and the maximum full-time staff is four (City of Seattle).
- None of the selected agencies has a quality management program.
- Of the insourcing and outsourcing options within each agency's chosen category, five were reported as fully or mostly insourced while six were reported as fully or mostly outsourced.
- When asked for the years of experience with the insourcing and outsourcing, one agency reported as 5-9 years and four agencies as more than 20 years.

5.1.2 Interview Questions

Interview questions were developed based on a combination of detailed questions and follow-on questions to understand agencies' operational and decision-making processes. Each agency representative was contacted to schedule an interview date and time. An interview scheduling notification was then sent via email with an attached copy of the agency's response to the web-based questionnaire in portable document format (PDF) for ease of reference. In addition, an editable document containing the questions for the respective TMS activity category for the interview was attached to the email for the agency representatives to prepare for the interview and reference for talking points. All interviews were conducted via teleconference. Most interviews were conducted by a minimum of two research team members, where one person led the interview and the other person typed responses into a form created specifically for the interviews. Representatives from FHWA participated in several interviews as passive listeners. Additionally, several agencies included multiple staff with various roles

and responsibilities for the interviews. The interview atmosphere was intended to be casual, where all agencies were asked the same questions for the respective selected category. All phone interviews were recorded with the permission of the interviewees, except for one where the agency representatives requested not to be recorded.

A list of the agencies and the contact information of the interviewees is included in *Appendix F*, and the interview questions under the three categories comprise *Appendix G*.

6.0 ASSESSMENT OF CATEGORY 1 ACTIVITIES - EQUIPMENT AND/OR SENSOR INSTALLATION

The objective of Category 1 activities is to document the successes and challenges associated with the practices of agencies that use internal or external resources for the installation of traffic monitoring equipment and peripherals such as traffic counters, WIM equipment, sensors, cabinets, pull boxes, communications and power lines, etc. Specifically, the assessment under this category focuses on the information that encompasses the equipment installation that is exclusively relevant to traffic data monitoring.

6.1 Description of TMS Sensor and Equipment Installation Services

The activities under Category 1 are listed below:

- Intrusive Continuous Counting Station (CCS) sensors (e.g., electromechanical types such as weight sensors, piezo, magnetic, inductive loop wire, magnetometers, bending plates, or a combination of the above sensor systems).
- CCS and equipment controller cabinets or complete CCS site installation
- Pull boxes (including lead-in wires and cables)
- Site installations including communication and power (including portable power sources)
- Non-intrusive sensor installation (e.g., radar, passive infrared, ultrasonic, acoustic, CCTV, SmartSensors™)

Due to the specific foci of this assessment on traffic data collection activities and contracting practices, installation of other types of detectors/sensors such as signal actuation, presence/passage detectors, machine vision, over-height sensors, weather sensors, etc. was not evaluated under this research project.

6.2 Agency Resourcing Profiles

As discussed in the previous sections, a set of criteria was used in profiling the agencies and determining the alignment of their experience, practices, and resourcing profile with the objectives of this project. Table 6-1 includes a list of agencies that were selected for interviewing, along with their profiles that were used in selecting those agencies.

Table 6-1. List of Agencies that were selected for Category 1 Interviews Their Resourcing Profiles

Agency	State	Category 1 Permanent Sensor and/or Equipment						
		Intrusive Continuous Counting Station (CCS) sensors	CCS and equipment controller cabinets or complete CCS site	Pull boxes	Site installations including communication and power	Non-intrusive sensor installation	Other	
Arkansas SHTD	AR	FI	FI	FI	FI	FI		
Michigan DOT	MI	FI	FI	FI	FI			
Minnesota DOT	MN	FO	FO	FO	FO	MI		
Montana DOT	MT	MI	MI	MI	MI			
New Mexico DOT	NM	FO	FO	FO	FO	FO		
Pennsylvania DOT	PA	FO	FO	FO	MO	FO		
South Carolina DOT	SC	MO	MO	MO	FI			
Wisconsin DOT	WI	FO	FO	FO	FO	FO		
Merrimack Valley Planning Commission	MA	FI	FI	FI	FI	FI		
Northeastern Indiana Regional Coordinating Council	IN	FI	MO	MO				
City of Seattle DOT	WA	FI	MI	MI	MI			

KEY
 FO Fully Outsourced
 MO Mostly Outsourced
 MI Mostly Insourced
 FI Fully Insourced
 N/A

6.3 Agency Interviews and Evaluation of Responses

6.3.1 Interview Questions

The interviews for Category 1 included six questions and one discussion question grouped under the following four categories:

- Organizational Practices
- Decision-Making Processes
- Quality Assurance/Quality Control (QA/QC)
- Proposed Processes (discussion question)

The categorized responses and discussions are further summarized in the proceeding sections following the questions. A list of the interview questions for each of the three categories is included in *Appendix G* for ease of reference.

The responses were summarized to only a select number of key interview questions. Responses presented a variety of the issues and challenges faced by the agencies, as well as experiences and solutions to those challenges and barriers identified by the state DOT, MPO, and local agency personnel that are involved in the administrative and technical aspects of traffic data collection.

Organizational Practices

1. You indicated that your agency in/outsources sensor and/or equipment installations.
 - a. How many years have you been in/outsourcing the sensor and/or equipment installations?
 - b. What are the benefits of in/outsourcing of the sensor and/or equipment installations?
 - c. Do you have documented design standards for your equipment installations and can you share one?
 - d. Can you briefly describe you inspection process for equipment installations?
 - e. Is the staff of inspectors insourced or outsourced?
 - f. If you have had both insourced and outsourced inspectors, have you noticed a difference in quality of the installed equipment?

2. You indicated that your agency is currently outsourcing most of its sensor and/or equipment installations even though your agency possess the necessary technical capabilities to manage TMS activities in-house.
 - a. Can you give some insight as to why your agency decided to outsource equipment installations when your agency possess the capability to do installations in-house?
 - b. If you have experience with both in- and outsourcing, do you believe outsourcing equipment installations improves quality, lowers quality, or is about the same when compared to insourcing?
 - c. Are there any barriers that prevent your equipment installations from being completed in-house?
 - d. What are those barriers? Did you ever take actions to overcome the identified barriers? What were those actions?

Decision-Making Processes

3. Your agency has a defined process for decisions regarding insourcing/outsourcing] equipment installations.
 - a. Can you briefly describe this process?
 - b. Is it formalized? Is the process documented?
 - c. Can you provide us with the documentation?
 - d. Does this process work well for your agency?
 - e. How could it be improved?
 - f. How long has your agency been using this procedure?
 - g. Has it undergone any recent changes? If so, why?
 - h. How does your agency evaluate the advantages/disadvantages of outsourcing versus insourcing?
 - i. In a perfect world, how would this process be handled?
 - j. Who makes the final decision in this process?
 - k. How often, or what, would cause this decision to be reevaluated?
 - l. What would you change in the current process to make improvements?

Quality Assurance/Quality Control (QA/QC)

4. Your agency keeps track of the reliability measures of continuous count stations (CCS) and weigh in motion stations (WIM).
 - a. Can you briefly describe this process?
 - b. What do the reliability measures cover (e.g. speed, volume, classification)?
 - c. How detailed are the measures (e.g., is the lane-by-lane percentage of availability recorded in an automated system)?
 - d. How is reliability measured? Is the system comparing the data to the historical data of the same detector zone or lane readings, or is the data compared to upstream and downstream detector data with an algorithm that balances the volume between the detectors?
 - e. What were/are the challenges with developing/tracking these measures?
 - f. What are the benefits of having reliability measures?
 - g. What would you change in the current process to make improvements?
5. Does your agency have a warranty policy for installation of the CCS and associated traffic monitoring equipment/sensors?
 - a. If yes, how many years does the warranty typically cover?

- b. Do you see it beneficial to have a warranty policy and what are the benefits of having a warranty policy in place?
6. Does your agency have documented requirements/processes for QA/QC for your equipment installations?
 - a. Can you briefly describe those requirements/processes?
 - b. Can you provide us with the documentation?
 - c. Do you see it beneficial to have a documented QA/QC policy? If yes, what are the benefits?
 - d. What would you change in the current QA/QC process to improve it or make it more effective/efficient?

Proposed Processes

The objective of the ‘Proposed Processes’ section was to gather information for use in the development of processes/matrices as part of the research recommendations. The agencies that provided substantial input for this section could be contacted once more after the recommendations were drafted. This section of the interview involved open discussions regarding specific agency experiences associated with the processes based on the resourcing type of the agency, lessons learned from past programs/practices, and feedback on potential processes presented by the research team. Examples of the latter include suggestions for process improvement measures, a decision-making process that could work for your agency (proposed but has not been implemented due a specific reason), or a process that you tried and refined after many iterations.

6.3.2 Summary of Interview Discussions

The following sections summarize the responses and discussion items. Please note that the annotation “No Response/Not Applicable” indicates that either the agency did not have any activities that were applicable to the topic discussed in a particular question/sub-question, or the responding agency did not have information regarding the question being asked. In addition, the process was selective in which questions/responses to include in the documentation. The questions/responses included in the report are primarily the questions that generated responses that could be summarized within a qualitative evaluation context and be meaningful for the intended audience of this report.

Question 1b: What are the benefits of in/outsourcing of the sensor and/or equipment installations?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Limited staff and resources to perform in-house installations. Additional equipment would need to be maintained and having someone with the required skillset is difficult to justify with only a couple installations per year.
Pennsylvania DOT	Fully Outsourced	Lacks equipment to do installations and lacks the appropriate staffing levels. The agency is unable (no authorization) to hire more staff. Outsourcing saves money under the current circumstances.
Wisconsin DOT	Fully Outsourced	Outsourcing eliminates the need to own or maintain the equipment.
Minnesota DOT	Mostly Outsourced	Counts are the contractor's priority, where agency staff could have other duties, thus does not prioritize traffic data collection.
South Carolina DOT	Mostly Outsourced	Lack of equipment to do installations and the technical expertise to do so. The benefit of insourcing connections is that the DOT can set the priorities and send staff immediately to check an issue.
Montana DOT	Mostly Insourced	Benefits of Insourcing: Insourcing allows for quick and flexible installations (time window for installations is small in Montana). We are able to quickly organize and go get it done in a quarter of the time as a contract install. Labor costs are already paid for so it is cheaper than contracting. We do installations all the time and employee turnover with contractors is high. We have all the equipment. Benefits of Outsourcing: Montana is geographically large so having installations contracted allows in-house crew to be working on other things. In-house staff would only be able to install one WIM sensor a year but the state is seeing value in WIMs and wants four WIMs installed a year. Cannot hire additional staff, and those staff would only be really needed during the short construction season.
Michigan DOT	Mostly Insourced	Contractors install sensors during road projects to save money while road is not open. Other times it is done in-house for better controlling the quality.
City of Seattle DOT	Mostly Insourced	Insourcing allows increased responsiveness and control over the equipment maintenance (also performed by in-house staff).
Merrimack Valley Planning Commission (MVPC)	Fully Insourced	Counts can be done with short notice and field operations can be modified quickly because the DOT staff is in the area. Emergency requests can be accommodated more rapidly than mobilizing contractors.
Arkansas SHTD	Fully Insourced	In-house staff is already being paid so doing installations in-house does not incur any additional cost. Staff is familiar with the state and can easily pick new sites.

Question 1b (continued): What are the benefits of in/outsourcing of the sensor and/or equipment installations?

Agency	Resourcing	Response
Northeastern Indiana Regional Coordinating Council (NIRCC)	Combination	No equipment or staff expertise to install CCS. For in-house activities, it is less expensive to do it in-house and important to have control over the quality of data.

The following were expressed by the interviewees as the immediate benefits of insourcing or outsourcing the sensor and/or equipment installation:

Insourcing

- Insourcing is cost-effective from a maintenance of equipment perspective
- Insourcing allows for in-house control of the data quality
- Insourcing allows for flexibility for the agency personnel to prioritize data collection activities
- Insourcing utilizes the current staff and does not require additional costs
- In-house staff are familiar with the sites and local settings

Outsourcing

- Outsourcing addresses the challenges associated with limited staffing and technical expertise, and frees up time of existing staff
- Outsourcing addresses the challenges associated with limited or lack of equipment inventory
- Outsourcing allows the agency to take advantage of contractors' expertise and methods used for efficient installation (such as responsiveness and short-notice mobilization or timing road construction and equipment installation projects)
- Outsourcing allows the agencies in colder climates for flexibility of resource allocation, because full-time staff would not have a well-distributed workload due to short periods when the weather permits installations.

Question 1d: Can you briefly describe you inspection process for equipment installations?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Not sure about the details of the field activities that involve inspections.
Pennsylvania DOT	Fully Outsourced	Field operations staff monitors installations by others, following/completing a standard checklist for documentation.
Wisconsin DOT	Fully Outsourced	Agency staff is typically present to ensure that the inspections are completed according to standards. Staff is also responsible for installing recorder in the cabinet, making connections, and making sure wiring is done properly; a service report is completed when work is done at a permanent station.
Minnesota DOT	Mostly Outsourced	Inspectors (contractors) check cuts and ensure that areas of concrete are large enough. Oversee inspections and only pay 70% before installation and remaining 30% after sensor works for 30 days.
South Carolina DOT	Mostly Outsourced	The ITS group has an in-house district engineer to perform the inspections.
Montana DOT	Mostly Insourced	A visual inspection when the site is operational. Watch vehicles as they pass over. The first calibrations are done with a known weight calibration truck; therefore, we can tell how accurate it is.
Michigan DOT	Mostly Insourced	Agency staff oversees everything contractors do and guide them through installation. The contract allows for a 15-day acceptance period after the installation is completed.
City of Seattle DOT	Mostly Insourced	Inspections are performed by the signal installation group.
MVPC	Fully Insourced	No Response/Not Applicable
Arkansas SHTD	Fully Insourced	There is no inspection checklist. The staff knows what to do next and they run like a “well-oiled machine.”
NIRCC	Combination	Inspections are performed in-house or, if needed, by Fort Wayne traffic engineering staff.

The inspection process for the insourced operations appears to follow a standard checklist that staff inspectors complete once they finish the inspection and document the installation quality. It was also noted that the majority of the agencies either perform formal inspections or have their staff present to monitor the process in the field. One noteworthy approach used by Minnesota DOT to ensure quality of installation involves payment penalties. Unsatisfactory quality detected in an installation could result in non-payment (fully or a certain percentage). Michigan DOT also uses a similar approach where the acceptance and payment is tied into the quality and operational functionality of the equipment after 15 days. Overall, when the installation of equipment is outsourced, having the state DOT staff or staff from other “sister” agencies/departments appears to be the preferred method to ensure quality of the equipment installation.

Question 2a: Can you give some insight as to why your agency decided to outsource equipment installations when your agency possess the capability to do installations in-house?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Agency does not possess the work force to do installations in-house.
Pennsylvania DOT	Fully Outsourced	The agency has always outsourced equipment installations and there has never been an evaluation/review process for in/outsourcing.
Wisconsin DOT	Fully Outsourced	Not enough in-house staff for an installation crew and cannot hire additional staff.
Minnesota DOT	Mostly Outsourced	Equipment installations were not the priority of the electrical services section of MNDOT so the agency decided to outsource to a contractor so that installations could be done on a reasonable scheduled basis.
South Carolina DOT	Mostly Outsourced	Agency does not possess the technical capability to do installations in-house.
Montana DOT	Mostly Insourced	WIM installations are done by contractors due to the volume of installations done in a year. It would not be feasible to hire the staff we would need during the short installation window, as they would not have work to do during the winter.
Michigan DOT	Mostly Insourced	Contractors are used to install and replace sensors during road construction/rebuilding projects so that they can be done quickly and easily while the road is open. A lot of this work is done during nighttime when in-house staff is not scheduled to work.
City of Seattle DOT	Mostly Insourced	Not Applicable
MVPC	Fully Insourced	Not Applicable
Arkansas SHTD	Fully Insourced	Not Applicable
NIRCC	Combination	It is more cost effective to outsource equipment installations to City of Ft. Wayne.

Although the responses varied amongst the agencies, the most common responses concentrated around the following:

- the agency did not have the in-house technical capability to perform the installations
- not enough staff to complete the required installations
- the activity has been outsourced for a while and the agency did not evaluate if outsourcing was the most feasible method (outsourcing is considered to be cost effective when compared to insourcing)
- installations are performed outside of the regular shift hours of the agency

Question 2b: If you have experience with both in- and outsourcing, do you believe outsourcing equipment installations improves quality, lowers quality, or is about the same when compared to insourcing?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Not sure, but the quality of installation might “go down” if insourced.
Pennsylvania DOT	Fully Outsourced	No Response/Not Applicable
Wisconsin DOT	Fully Outsourced	About the same.
Minnesota DOT	Mostly Outsourced	Either improved or the same. Contractors know the expectations and the relationships are strong.
South Carolina DOT	Mostly Outsourced	Outsourcing results in lower quality versus having in-house staff given their loyalties to the agency. Contractors will not take the time to check count issues. Equipment inspections performed by the in-house staff revealed improper installations and sometimes the installation not being in the proper place. Local in-house staff knows the area, traffic patterns, and where to place short-term count equipment.
Montana DOT	Mostly Insourced	WIM installs are as good of a quality as in-house. If our staff had to do four installations per year, then the quality would suffer due to the high amount of work. The result is good because of the inspection while the installs are being done.
Michigan DOT	Mostly Insourced	Not Applicable
City of Seattle DOT	Mostly Insourced	Not Applicable
MVPC	Fully Insourced	Not Applicable
Arkansas SHTD	Fully Insourced	There was one previous contract for installations that yielded a lower quality product.
NIRCC	Combination	Not Applicable

Interviewees generally believe the quality of work of their current resourcing practices to be better or comparable to the quality of work done utilizing an alternative resourcing practice. One interviewee (SCDOT) indicated that the quality of installations would be better if they were done in-house even though they currently outsource the installations. Another agency, Arkansas SHTD, indicated that their previous experience with outsourcing yielded a lower quality product when compared to their current in-house installations. The main rationale for this belief is that in-house staff is “loyal” to the agency and are concerned about the quality of work more than the contractors typically are. SCDOT indicated that they found unsatisfactory installations on several occasions.

Although it was not explicitly expressed by the interviewees that the quality of the data deteriorates with outsourced equipment installation and/or inspection, it was gathered that the agencies would like to have control over the installation or inspections to a certain degree in order to ensure the quality of the data collected by such equipment. This was mainly due to common belief that the agency staff has more institutional knowledge about the area within the jurisdiction’s domain, better understanding of agency objectives associated with quality, and a keener tendency to look out for the agencies’ overall financial and operational benefits.

Question 2c: Are there any barriers that prevent your equipment installations from being completed in-house?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Limited staff, staff training needs for installation, understanding technical requirements of equipment, and safety concerns for the DOT staff.
Pennsylvania DOT	Fully Outsourced	The agency has no experience insourcing; therefore, it is difficult to assess if in-house capability exists or can be developed.
Wisconsin DOT	Fully Outsourced	Too few staff and do not have the equipment, nor are funds available.
Minnesota DOT	Mostly Outsourced	No Response/Not Applicable
South Carolina DOT	Mostly Outsourced	Staffing limitations and management perception that outsourcing is less expensive.
Montana DOT	Mostly Insourced	Limited staff and training needs for installation, understanding of equipment, and safety.
Michigan DOT	Mostly Insourced	Not Applicable
City of Seattle DOT	Mostly Insourced	Not Applicable
MVPC	Fully Insourced	Not Applicable
Arkansas SHTD	Fully Insourced	Not Applicable
NIRCC	Combination	Not Applicable

In summary, the interviewees listed the following barriers as preventing them from installing equipment using in-house resources, even though their agency possesses the technical capability to do so:

- staff shortages and/or recent staff reduction
- training requirements
- lack of experience within agency to complete the tasks in-house
- management perceives outsourcing to be the less expensive alternative when compared with insourcing
- lack of equipment
- lack of funding to purchase equipment
- lack of funding to hire staff

Question 2d: What are those barriers? Did you ever take actions to overcome the identified barriers? What were those actions?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	No Response/Not Applicable
Pennsylvania DOT	Fully Outsourced	The agency lacks the staff with technical capabilities to do installations in-house, no way to hire new staff, and no equipment, storage capacity, and logistical ability; it would not be feasible to buy equipment that could not be used for 4 months of the year.
Wisconsin DOT	Fully Outsourced	Too few staff and are not authorized to fill additional positions, do not have the equipment, and do not the funds available to do so.
Minnesota DOT	Mostly Outsourced	No Response/Not Applicable
South Carolina DOT	Mostly Outsourced	Management policies regarding staffing limitations will not allow insourcing, and must outsource more as staff is lost. Upper management thinks it is less expensive to outsource but a study has not been done on that yet.
Montana DOT	Mostly Insourced	If it is a new construct job then the funding can be part of the highway project, so outsourcing helps the funding. No real reason to try to do these in-house since new staff would have downtime in the off-season. Most of the initial problems were a few years ago when we were just getting back into contracted installs.
Michigan DOT	Mostly Insourced	Not Applicable
City of Seattle DOT	Mostly Insourced	Not Applicable
MVPC	Fully Insourced	Not Applicable
Arkansas SHTD	Fully Insourced	Not Applicable
NIRCC	Combination	Not Applicable

The common themes that were preventing agencies from insourcing equipment installation were observed to be the following:

- lack of staffing or staffing reductions
- lack of funding for buying and maintaining equipment

Agencies that mostly or fully outsource their equipment installation activities believed that outsourcing decisions were being made without properly evaluating the alternatives using methods such as benefit/cost analyses, financial feasibility studies, or an overall feasibility evaluation to document the clear advantages and disadvantages of in/outsourcing.

Question 3a: Your agency has a defined process for decisions regarding [outsourcing/insourcing] of equipment installations. Can you briefly describe this process?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Currently, re-evaluating all levels of the program to improve existing processes and equipment, and put policies in place for working in the field and understanding data requirements to become compliant with FHWA requirements. Currently, training staff on traffic monitoring. Planning to continue outsourcing in the interim until a different solution is developed.
Pennsylvania DOT	Fully Outsourced	PennDOT's contract processes and decisions are established by procurement staff at the State level.
Wisconsin DOT	Fully Outsourced	Decided to outsource due to legislative and agency actions at a higher level. The agency was forced to develop an approach in response to not having enough people available to do installations in-house.
Minnesota DOT	Mostly Outsourced	Number of installations in the state would not keep a staff employed full time.
South Carolina DOT	Mostly Outsourced	No defined process: the agency would prefer to do installations in-house, but currently outsourcing the activity due to staff shortages. Management also believes that it is less expensive to outsource.
Montana DOT	Mostly Insourced	A formalized process likely would not work, so cannot think up a good reason for it. We want to determine the size of staff we need based on current factors. If at that point, do we go contracted install or just say this is as big as it is getting so we start retiring WIM sites. We are trying to keep the ATRs ¹¹¹¹ solely insourced.
Michigan DOT	Mostly Insourced	Agency does everything in-house unless it is during road construction/rebuild.
City of Seattle DOT	Mostly Insourced	Consistency would be a big issue. For example, work on signals as part of capital projects is done in-house by an electrician for the sake of consistency.
MVPC	Fully Insourced	If current staff was to leave, might have to reconsider the practice/insourcing. Quality of data collected by contractor-installed equipment could not always be dependable. DOT staff is a representation of the agency.
Arkansas SHTD	Fully Insourced	The agency will be evaluating a contracted installation in the Spring to determine how long it takes the contractors to complete the installation, the number of lane closures, queue length, how long pavement stays in good condition, and how disruptive they are to traffic.
NIRCC	Combination	No Response/Not Applicable

¹¹ ATR - Automated Traffic Recorder is another (older) term used for Continuous Counting Stations (CCS).

A noteworthy observation during the interviews was that, 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. Some of the challenges that seem to direct agencies to outsourcing included legislative mandates regarding staffing levels the agency is allowed to maintain, limitations due to geographic coverage where the agency does not have sufficient work to maintain full-time staff throughout the year, needed seasonal flexibility where the field operations are suspended, cost of maintaining equipment that is used on only rare occasions, etc. The perceived rationale behind the majority of the outsourcing agencies appeared to be “cost savings and efficiency,” although not evaluated or documented formally.

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 majority of the agencies that preferred insourcing justified their decisions by flexibility in human resource allocation, thus controlling the budgets and funding. However, as with the outsourcing agencies, decisions for insourcing were not evaluated or documented formally.

As discussed above, the consensus among interviewees was that their current equipment installation resourcing profile was not subject to a well-documented or structured decision making process. Nearly all interviewees indicated that the decision to utilize current practices was dependent on external or internal factors as shown in the following *Table 6-2*.

Table 6-2. Observed Internal and External factors influencing Agency Decisions

Factor (external or internal)	Generally applies to:
“Habitual” contracting practices (business as usual)	Insourcing and Outsourcing
Most feasible approach to completing the tasks under understaffed conditions	Outsourcing
Executive/senior management decisions and/or instructions	Outsourcing
Trust in agencies’ in-house staff	Insourcing
Better quality	Insourcing and Outsourcing
Better budget control	Insourcing
Flexibility in use of contractor time on an as-needed basis	Outsourcing
Reduced cost to purchase and maintain rarely used equipment	Outsourcing
More cost efficient (undocumented)	Outsourcing

Many decisions to outsource were due to a lack of staffing levels necessary to maintain a program in-house. Staffing reductions or hiring freezes are a result of the common approach that outsourcing is publically perceived to be financially more feasible, because most contractors’ agreements are on either on-call or as-needed basis, thus not requiring funding commitments similar to full-time government employees. This approach provides flexibility to the agencies during recessionary periods where funding for data collection equipment installation and maintenance can be scaled back to perform only the “essential” activities. During such times, funding can also be re-allocated to a different area and/or contract, whereas the re-allocation of agency staff is not as flexible or feasible.

However, based on the discussions during the interviews, this perception of cost-efficiency appears to describe “effective resource allocation” rather than “cost-efficiency of operations.” The agencies could not identify any exercise that they undertook where a comparison of the cost for outsourcing or insourcing the same activity is documented (or estimated). In other words, the contractor being available to perform the work on an as-needed and when-needed basis appeared to be perceived by agencies as “cost savings.” Whereas, the same activity could have been performed by a contractor or in-house staff and the unit cost to complete the work could be the same, thus neither resourcing method has a significant financial benefit or cost efficiency over the other.

While one insourcing agency noted pressures to avoid contractors due to their high overhead rates, most agencies are pressured to outsource for the opposite reason of publically perceived higher efficiency in the private sector. However, it is also important to note that having dedicated full- or part-time staff for the same activity could prove to be more cost efficient or not, but maintaining a year-round full workload for the in-house staff appeared to be the essence of the decision influence. Addition of the capital investment needed for specialized construction equipment should also be factored in the cost-efficiency based decisions, because the analysis period used in the life cycle could skew the benefits towards outsourcing in the short term, but towards insourcing in the long term. While not documented, the potential differences in costs incurred and efficiencies gained from either in-house or outsourcing may result in approximately equal costs for either practice.

Question 4a: Your agency keeps track of the reliability measures of continuous count stations (CCS) and weigh in motion stations (WIM). Can you briefly describe this process?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Staff pulls a report weekly that shows any data issues, and field crew check the station to see if there is a problem with it; most issues are connection issues.
Pennsylvania DOT	Fully Outsourced	WIM stations are calibrated annually using a truck with a known weight. The CCS have an established schedule, occurring either every one or every three years, with a four-hour manual count performed and compared to sensor data. If the data points lie outside of a +/-3% range then the agency attempts to figure out the problem. If the agency detects a reoccurring problem then the site will be moved up in the schedule and a QA is done.
Wisconsin DOT	Fully Outsourced	All CCS data are pulled nightly which allows staff to identify and respond to communications issues in the morning. There are quality checks built into the processing software that includes warnings or errors based on thresholds. Equipment is calibrated annually in the field.
Minnesota DOT	Mostly Outsourced	QC is done during reporting. System will flag anomalies based on a comparison of the current data to the historically acceptable range of data.
South Carolina DOT	Mostly Outsourced	ITS department goes to each site to check sensors and boxes. There is no formal database or spreadsheet, but the staff manually identifies what is out of range. The agency does not perform daily checks. New programs will perform automatic checks and provide a short list of “bad” counts.
Montana DOT	Mostly Insourced	One person monitors WIM data and another person monitors the rest of the data, which is pulled daily and manually reviewed. If there are questions, a member of the field crew will go to the site. We do 4-hour manual counts on all the sites quarterly.
Michigan DOT	Mostly Insourced	Collects data daily so the agency knows what is and is not working each day. Staff checks the data manually.
City of Seattle DOT	Mostly Insourced	Software and sensors have routine built-in notifications including outages, uptime, and ability to transmit
MVPC	Fully Insourced	No Response/Not Applicable
Arkansas SHTD	Fully Insourced	Data is reviewed as it comes in and the distribution of classes is checked. Will also check front axle weights. These checks are mainly manual and compared to historical data. Will check weight station data against WIM data annually.
NIRCC	Combination	Sometimes weekly checks are performed given more equipment malfunctions during the winter, otherwise 1-2 times per month. CCS are standalone that run on battery power, and are individually checked on a routine basis.

Based on the responses received for reliability, it was observed that all agencies have different methods and frequencies to check and measure equipment reliability. This observation was somewhat expected because of the following:

- agencies use equipment from different manufacturers (thus different calibration/ground-truthing requirements)
- agency standards and data quality/acceptance thresholds are different
- the geographic location of the agencies coverage area necessitates different frequencies for equipment checks and calibration for reliability measures
- staffing level and technical expertise at each agency is different

However, another key observation was that the all interviewed state DOTs have performance and reliability measuring procedures in place (documented or undocumented) and such measures are compared to a set of historical data using agency-specific quality standards/thresholds before the data are accepted.

Question 4e: What were/are the challenges with developing/tracking these measures?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	No Response/Not Applicable
Pennsylvania DOT	Fully Outsourced	No issues; the automated process works well.
Wisconsin DOT	Fully Outsourced	The cost and time to conduct such frequent calibrations and identifying useful length bins.
Minnesota DOT	Mostly Outsourced	Tracing reliability measures is very labor intensive and considering deploying a new traffic data management software that will make process more automated.
South Carolina DOT	Mostly Outsourced	Funding and contracts were an issue in the development process.
Montana DOT	Mostly Insourced	Making the decision as to when someone to the field can be challenging: you do not want to send someone all the way across the state when it is true data.
Michigan DOT	Mostly Insourced	No challenges were experienced.
City of Seattle DOT	Mostly Insourced	Have not validated much; mainly getting information concerning reliability of connections.
MVPC	Fully Insourced	No Response/Not Applicable
Arkansas SHTD	Fully Insourced	Lack of staff
NIRCC	Combination	No Response/Not Applicable

Although the responses were varied, it was noted that several agencies rely on the built-in reliability monitoring and reporting features of the third-party software (custom-designed or off-the-shelf). Automation of reliability monitoring by use of software products (built-in or add-on) also appeared to be preferred by many agencies because it minimizes the staff time and training when compared with manual checks in the field. Several agencies indicated that the funding and staff-time requirements at the initial stages to develop the automated reliability monitoring systems were a concern.

Question 4g: What would you change in the current process to make improvements?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Need a maintenance and calibration schedule for these stations to ensure that the data are recorded over time.
Pennsylvania DOT	Fully Outsourced	Doing QA more frequently, but personnel, time, and funding limit this.
Wisconsin DOT	Fully Outsourced	No Response/Not Applicable
Minnesota DOT	Mostly Outsourced	Would like to be able to do additional and more thorough checks on classification data.
South Carolina DOT	Mostly Outsourced	The agency has a good handle on improvements in the new system, but will have to use it and look at data to see what may need to be changed.
Montana DOT	Mostly Insourced	Nothing, the biggest challenge is the geographic size of the state.
Michigan DOT	Mostly Insourced	Nothing. The process has been refined over many years, but not documented yet. Each person knows how to do his or her own job well.
City of Seattle DOT	Mostly Insourced	Need more staff to do more of this work. The current system used for collecting/processing the data is limiting
MVPC	Fully Insourced	No Response/Not Applicable
Arkansas SHTD	Fully Insourced	Would like to automate and plot weight data so it can be checked quickly. Overall, just need a better way to check weight data.
NIRCC	Combination	It would be nice to be able to check them remotely to make sure they are functioning properly.

Due to the variation of responses related to reliability measures and methods/processes to monitor them, desired improvement measures also varied. However, it was noted that the agencies' direction to improve the reliability and data quality appeared to move towards automation of reliability checks and monitoring. It was also observed that the needed improvements are determined based on the agencies' needs, observations, and evolving expectations and the improvements are implemented on a phased throughout the software development/refinement process.

Question 5a: Does your agency have a warranty policy for installation of the CCS and associated traffic monitoring equipment/sensors? If yes, how many years does the warranty typically cover?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	90-day warranty from the contractor. Possibly a 2-year equipment warranty from the manufacturer.
Pennsylvania DOT	Fully Outsourced	One year.
Wisconsin DOT	Fully Outsourced	No warranty, WISDOT staff checks the installation and equipment when the contractor is finished with work. WISDOT staff identifies any required corrections, but no other warranty.
Minnesota DOT	Mostly Outsourced	One year.
South Carolina DOT	Mostly Outsourced	30 or 60 days to monitor the installed sensors to make sure they are working properly.
Montana DOT	Mostly Insourced	One year.
Michigan DOT	Mostly Insourced	Just the manufactures warranty and the 15-day acceptance period for contractor work.
City of Seattle DOT	Mostly Insourced	No Response/Not Applicable
MVPC	Fully Insourced	No Response/Not Applicable
Arkansas SHTD	Fully Insourced	For the contract in the Spring, there will be a one-year warranty.
NIRCC	Combination	No Response/Not Applicable

Given the different equipment types and brands are used by the agencies and contractors, it is difficult to standardize the warranty period for the equipment. However, it was identified that the manufacturer’s warranty on the CCS equipment and peripherals are typically one to two years, whereas, the warranty for the installation by the contractor is negotiated on a case-by-case basis during the contracting process. The interviewed agencies indicated that the installation is either under warranty by the contractor for replacement or repair at no cost to the agency within the specified period (typically 15 to 90 days). In addition, some agencies such as Minnesota DOT structure their contract to withhold a certain percentage (currently 30%) of the payment to be released to the contractor after monitoring the functionality and performance of the installed equipment for 90 days.

Question 5b: Do you see it beneficial to have a warranty policy and what are the benefits of having a warranty policy in place?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Yes, if there is system failure then we want to make sure that the manufacture is accountable and that the equipment is fixed.
Pennsylvania DOT	Fully Outsourced	Yes, if the site were installed wrong then the installers would have to go back and make corrections.
Wisconsin DOT	Fully Outsourced	Not sure there would be much benefit or easy to administer.
Minnesota DOT	Mostly Outsourced	Yes, has been issues with installations that contractor had to fix. Typically no problems post-installation as we catch them in the installation process.
South Carolina DOT	Mostly Outsourced	Yes, it would be beneficial because contractors have installed the wrong size loops or the wrong equipment, or damaged sensors.
Montana DOT	Mostly Insourced	Yes, we have had sensors fail and the company had to replace it.
Michigan DOT	Mostly Insourced	Yes, occasionally is useful. Contractor must reinstall sensors if not installed properly the first time.
City of Seattle DOT	Mostly Insourced	No Response/Not Applicable
MVPC	Fully Insourced	No Response/Not Applicable
Arkansas SHTD	Fully Insourced	Yes, it allows staff to become familiar with a site before they become accountable for it.
NIRCC	Combination	No Response/Not Applicable

The majority of the state DOTs found the warranty procedures beneficial for their agency, because they would have the contractors to correct any issues associated with installation workmanship or the equipment malfunctions. However, it should be noted that the period when the data could not be collected due to installation or equipment errors is not covered under any of the warranties (contractor or equipment manufacturer).

Question 6a: Does your agency have documented requirements/processes for QA/QC for your equipment installations? Can you briefly describe those requirements/processes?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	This is one of the new processes that we are currently working to develop.
Pennsylvania DOT	Fully Outsourced	No Response/Not Available
Wisconsin DOT	Fully Outsourced	Have the manufacturer instructions for equipment installation, past practices were documented, and service reports that are filled out.
Minnesota DOT	Mostly Outsourced	Requirements are established in the contracts. Standard specifications are use. WIM has to classify 95%.
South Carolina DOT	Mostly Outsourced	For permanent counts, the ITS group has very detailed, documented processes.
Montana DOT	Mostly Insourced	Not aware of anything. Never had issues but have trust with current staff.
Michigan DOT	Mostly Insourced	The agency has a process to make sure installations are working correctly and interrogates the system in-house nightly.
City of Seattle DOT	Mostly Insourced	No Response/Not Applicable
MVPC	Fully Insourced	Inspector can verify that the read on the counter is within the range it should be manually. Then balance downloaded data with historical data. Automatic checks are done when uploaded to MassDOT's MS2 online database.
Arkansas SHTD	Fully Insourced	There is a checklist for WIM sites that the staff goes through every time they are at the site.
NIRCC	Combination	No Response/Not Applicable

Based on the responses to the documented requirements for QA/QC, the policies/procedures of the agencies appeared to be very agency specific, as well as dependent on the equipment manufacturers' specifications. A discussion regarding the evaluation of the QA/QC processes is included in the previous sections where the overall assessment data is evaluated in Chapter 4.

Question 6c: Do you see it beneficial to have a documented QA/QC policy? What are the benefits?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Yes, knowing that the equipment is properly functioning is key; continuity of operations after staff changes is also important.
Pennsylvania DOT	Fully Outsourced	Yes, it allows for consistent installations and standardization between all the installation sites.
Wisconsin DOT	Fully Outsourced	Yes, it is beneficial to have it documented to know what QA/QC checks are being applied by software, how the data are being evaluated, and identify the necessary changes, as needed. Contractors have a better understanding about what Wisconsin DOT inspects for installations.
Minnesota DOT	Mostly Outsourced	No, have not had many issues. The agency only installs one type of controller for each sensor and having processes documented allows the agency to justify only having one type of sensor since many other systems would have to change. Hoping to improve QA/QC with new system.
South Carolina DOT	Mostly Outsourced	Yes, documentation allows higher accountability and helps to make sure milestones are met and everyone is on the same page.
Montana DOT	Mostly Insourced	It would definitely be beneficial to have.
Michigan DOT	Mostly Insourced	No, it would be a lot to document and staff probably would not use it because they are more hands on.
City of Seattle DOT	Mostly Insourced	No Response/Not Applicable
MVPC	Fully Insourced	No Response/Not Applicable
Arkansas SHTD	Fully Insourced	Yes, staff knows what they have to do and it holds them accountable.
NIRCC	Combination	No Response/Not Applicable

Although agencies have different QA/QC procedures and documentation levels, there is consensus on the following key benefits realized by the interviewed agencies:

- allows monitoring if the equipment is functioning properly
- ensures continuity of operations after staff changes
- provides consistency and standardization of installations
- provides higher accountability
- allows tracking of procedures/processes and makes it easy to make changes

Question 6d: What would you change in the current QA/QC process to improve it or make it more effective/efficient?		
Agency	Resourcing	Response
New Mexico DOT	Fully Outsourced	Currently creating a geo-database of equipment locations. Need to document whether equipment is electrical powered or solar powered.
Pennsylvania DOT	Fully Outsourced	No changes necessary.
Wisconsin DOT	Fully Outsourced	No Response.
Minnesota DOT	Mostly Outsourced	Want to make the system more automated to save time so staff can do additional analysis and additional tasks.
South Carolina DOT	Mostly Outsourced	No changes necessary, because everything works well.
Montana DOT	Mostly Insourced	No real changes to make.
Michigan DOT	Mostly Insourced	Not Applicable.
City of Seattle DOT	Mostly Insourced	No Response.
MVPC	Fully Insourced	No changes to make, but would be open to anything that could improve the process.
Arkansas SHTD	Fully Insourced	Would like to have a way for everything to roll into a database via a tablet or smartphone.
NIRCC	Combination	Would like to be able to access equipment remotely.

6.4 Rationale for Agencies' Resourcing Practices for their Sensor and/or Equipment Installation

The majority of the interviewed state DOTs were unable to cite an established or documented decision-making process for insourcing/outsourcing sensor and equipment installations. 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.

While a number of the state DOTs are forced to outsource equipment installations due to factors beyond their control, such as state legislation or statewide actions, there was little concern among agencies that outsourcing lowers equipment installation quality or the data collected using the equipment installed by third-party contractors. Only one agency stated that they felt outsourcing equipment installations lowered the quality of installations and the associated data quality. On the other hand, based on the agencies that are interviewed, insourcing also has several merits such as 100 percent control over the installation activity (i.e., timing, scheduling, resource allocation, etc.), controlling the quality of equipment installation, and flexibility in prioritizing the work activities.

In summary, although the realized benefits for both insourcing and outsourcing were discussed in detail and somewhat documented, it was noted that the process behind the decision-making was not necessarily documented formally by the agencies. *Figure 4-16* in Chapter 4 also confirms that approximately 30 percent of the agencies that responded to the questionnaire indicated that they have a documented process/procedure for their decision-making. The percentage among the state DOT's that responded is approximately 34 percent. Unsurprisingly, the documented decision-making processes and their level of formality vary greatly among the agencies due to their needs, management's style, contracting history, staffing levels, funding, and technical capabilities among many other factors.

6.5 Experiences, Challenges, and Success Stories of Agencies for Sensor and/or Equipment Installation Activities

There were numerous experiences shared during the interviews that would be impractical to include in this document, given that many experiences were unique and specific to a particular agency's operations, structure, or organizational culture. However, throughout the interviews, several key challenges and experiences were found noteworthy to highlight.

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.

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. Nearly every agency indicated that a documented QA/QC process would be beneficial to the agency, even if the staff may not always choose to read it and follow such guidelines. Agencies also indicated that having a warranty policy for equipment installations is beneficial and helps to keep contractors accountable.

Dependencies - A number of the interviewed MPOs and local agencies relied on partnerships for both count equipment, expertise, and QA/QC. For example, NIRCC relies on the city of Fort Wayne to assist with installations if the agency is unable to do them in-house and MVPC utilizes MassDOT's MS2™¹² system to assist in QA/QC of data. These partnerships are often times mutually beneficial to each agency involved and ensure an open exchange of count data.

6.6 Summary of Best Practices reflecting Cost and Time Efficiency, Effectiveness, and Reliability for Sensor and/or Equipment Installation Activities

Interviewed agencies indicated having a warranty for equipment installations in place guarantees that a contractor's work is done properly and, if not done properly the first time, requires the contractor to return to the site to fix the installation to agency standards. Additionally, most contractor mistakes can be preempted by having inspectors monitor the equipment installations and ensure the work is done properly.

One agency that was interviewed, the New Mexico DOT, is currently undertaking a comprehensive review of its traffic monitoring program. A contractor was hired to examine current agency practices, Federal requirements, and best practices from other agencies in order to assess the areas where changes

¹² <http://www.ms2soft.com>

are needed thoroughly and other improvements that could result in greater efficiency, better practices, and cost savings. This type of periodic re-examination of agency processes is a recommended best practice. While this re-examination need not be a major effort, it may include verification that the agency traffic monitoring program is compliant with Federal requirements, has documented decision-making, equipment installation, and QA/QC procedures, and a benefit/cost analysis to compare insourcing versus outsourcing practices. When making decisions regarding insourcing or outsourcing, agencies need to consider the period of their benefit/cost analysis, because the funding needed for the required capital investments in the specialized construction equipment would have an influence on the outcome of the benefit/cost ratio.

Having QA/QC procedures documented 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. Agencies indicate that knowing that equipment is installed correctly is very important to defending data quality, especially in a time when data are utilized internally as sources for operational and safety analyses, planning, design, validation, and forecasting reasons, as well as by external customers such as the MPOs, planning agencies, and the general public.

6.7 Perceived Advantages and Disadvantages of Insourcing or Outsourcing Sensor and/or Equipment Installation

Interviewed agencies perceive the advantages of insourcing sensor and/or equipment installations as providing both better quality installations and resulting data. Agencies also indicate that the data are less expensive than if it were collected by a contractor. This often time is a result of in-house staff living in and around the areas where counts are being conducted and therefore having more familiarity with the traffic patterns.

Interviewed agencies also indicated that installation responsiveness is a big factor in deciding to complete their sensor and/or equipment installations in-house. Agencies can easily dictate when the equipment will be installed; therefore, they can send a staff member very quickly to check on a site if there is a perceived issue with equipment. Equipment installations are a priority of the agency and can therefore take priority over other issues that a contractor might face.

The primary disadvantage of insourcing equipment installations is the funding, resources, and staffing levels required to complete the installations in-house. Agencies must maintain equipment and staff all year even though their sensor and equipment installation season might be short and the agency may only perform a few installations a year.

Interviewed agencies perceive the advantages of outsourcing sensor and/or equipment installations as being similar to the advantages of insourcing the equipment installations. The agencies who outsource installations find that doing so saves the agency money, produces as good or better quality, and keeps the agency from having to maintain high staff level and maintain installation equipment. An interviewed agency also indicated that a benefit of outsourcing installations is that the installations are a priority of the contractor and do not fall behind in the priority list as they might do if they were done in-house.

The disadvantage of outsourcing equipment installations for many agencies was the cost. Agencies indicated a high cost compared to the installations being done in-house. Agencies also indicated that outsourcing equipment installations prevents the agency from being able to complete installations or make repairs on short notice. There was not a consensus among interviewed agencies, however, that outsourcing equipment installations yielded a poorer quality installation.

6.8 Summary of Findings – Category 1 Activities

The following is a list of the noteworthy findings based on the responses to the web-based questionnaire, agency interviews, and information gathering:

- Nearly every agency that was interviewed indicated that decisions regarding their agency’s resourcing practices are made at a level of management higher than the agency department/office that is responsible for actually completing the TMS sensors and equipment installations.
- Many of the interviewed agencies underwent staffing caps, inadequate staffing allocations, funding shortages, and other insufficient resources that forced them to resort to outsourcing sensor and equipment installations.
- 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 their equipment installations.
- 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. 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.
- Many of the agencies that outsource their equipment installation activities based on the cost-efficiency based decisions. However, based on the discussions during the interviews, the perception of cost-efficiency appears to describe “effective resource allocation” rather than “cost-efficiency of operations.”
- Though many agencies are forced to outsource installations due to state-imposed constraints, there was not a consensus among agencies that outsourcing the equipment installation contracts diminish the quality of the installations or the resulting traffic count data and/or weigh measurements. Only one agency felt that outsourcing equipment installations lowers installation quality.
- Of the agencies that insource equipment and sensor installations, the primary benefits of doing so is the relatively low cost compared to contractors, flexibility, and responsiveness of installation time, ability to maintain low staffing levels, and elimination of the need to maintain installation equipment.
- Agencies largely find it beneficial to have documented QA/QC procedures to reduce the impact of staff turnover, ensure data check consistency, and guarantee confidence in the final data product. Agencies also largely find it beneficial to have established and documented installation warranties in place, but that many issues with faulty installations can be preempted by having a robust inspection process in place.

6.9 Conclusions– Category 1 Activities

Current traffic monitoring contracting practices of state DOTs, MPOs, and local agencies involve varying levels of insourcing or outsourcing for both installation of count equipment and execution of traffic counts, ranging from fully insourced/outsourced to partially insourced/outsourced. Limited documentation is available regarding the decision-making processes that support full or partial insourcing or outsourcing of state DOTs and other agencies' traffic monitoring program activities. This reflects, in many cases, a lack of defined processes behind resourcing decisions, as well as any basis for re-examination of those decisions at any pre-defined times.

This research assessed the advantages and disadvantages that state DOTs, MPOs, and local agencies experience while insourcing or outsourcing the sensor and equipment installations required for their traffic monitoring systems. The research team received 79 responses to an online TMS resourcing profile assessment, with 41 coming from state DOTs, 32 from MPOs, and six originating from local transportation agencies. The research team conducted interviews with 18 state DOTs, eight MPOs, and three local agencies, totaling 31 interviews to gather additional information about agency practices, resourcing rationale, decision-making processes, and other QA/QC activities for equipment and/or sensor installations, portable and permanent counts, and innovative contracting practices..

For the initial online assessment, there was a near-even split among responding DOTs and MPOs for fully or mostly insourcing and fully or mostly outsourcing TMS activities. All local agencies reported either fully insourcing or mostly insourcing TMS activities related to sensor and equipment installation. The majority of agencies that were interviewed about sensor and equipment installation category indicated that decisions regarding their agency's resourcing practices are made at a level of management much higher than the agency department that is responsible for actually completing TMS sensors and equipment installations. A pattern of staffing caps, inadequate staffing allocations, funding shortages, and other insufficient resources that forced them to resort to outsourcing sensor and equipment installations emerged and were listed among the primary reasons for many agencies outsourcing equipment installations.

Most agencies lack a defined decision-making process, in part because decisions regarding resourcing practices are largely decided for many agencies by legislated staffing caps, for example. 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 their equipment installations. Although many agencies outsource installations due to state-imposed constraints, there was no concern among agencies that outsourcing installations diminish the quality of the installations or the resulting count data. Only one agency felt that outsourcing equipment installations lowers installation quality. Of those agencies that do insource equipment and sensor installations, the primary benefits of doing so were listed as the relatively lower cost compared to contractors, flexibility and responsiveness of installation time, and confidence in equipment installation quality.

Interviewed agencies at all levels find it beneficial to have documented QA/QC procedures to reduce the impact of staff turnover, ensure data check consistency, and guarantee confidence in the final data product. Agencies also find it beneficial to have established and documented installation warranties in place, but that many issues with faulty installations can be preempted by having a robust inspection process in place.

While traffic count data are mandated by Federal law in the delivery of Federal-aid highway program to States and local agencies, nearly every agency, at all levels of government, utilize different strategies to collect their required data. Every interviewed agency utilized a unique strategy that they find feasible and effective. Even though the decisions to pursue a particular resourcing profile are beyond the control of

agencies that are performing counts and installing the necessary equipment, there was not a consensus that one particular resourcing strategy resulted in higher quality sensor or equipment installations.

A prevailing theme throughout agency interviews was the necessity and benefit of documenting agency procedures and policies related to TMS practices. Nearly every agency stressed the importance and the benefit of documentation of decision-making processes, equipment warranties, and QA/QC procedures. This documentation for these practices and policies can greatly reduce the impact of staff turnover, preserve institutional knowledge, ensure that all agency staff members are following standardized procedures, and help to increase confidence in equipment installations and resulting count data.

6.10 Recommendations – Category 1 Activities

Every agency interviewed performed some level of QA/QC on their count data and many performed QA/QC on their equipment installations. While these checks varied from manual to automatic and up/down stream to historical, every agency indicated that these checks are critical to the agency practices. These processes, whether documented or undocumented, help to ensure equipment is installed and functioning correctly and contributes significantly to data quality and confidence.

Many interviewed agencies maintain and benefit from enforcing a warranty policy for sensor and/or equipment installations. Such policies are not only beneficial to those agencies who rely on contractors for their equipment installations, but also can be used by all agencies to require a specific warranty period for count equipment. Agencies that outsource equipment installations benefit from equipment installation warranties by guaranteeing that contractor installations will be to the agency's standards and function properly post-installation.

For agencies that have the flexibility to make decisions regarding the resourcing profile of their sensor and/or equipment installations, there is a substantial benefit to having a defined decision making process for resourcing practices. This decision-making process helps to objectively evaluate the resourcing options and determine the unique option that works best. These agencies also benefit from a periodic re-evaluation schedule for resourcing practices. Many interviewed agencies have been utilizing their current practices for over 20 years with no reconsideration of these practices. A periodic re-evaluation schedule helps to ensure that the agency's resourcing practices stay up to date through ever-evolving technology, agency staff capabilities, and costs of equipment installations and performing counts.

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. Similar to the reevaluation undertaken by New Mexico DOT, each agency must evaluate the options available to them to choose their most suitable resourcing profile.

7.0 ASSESSMENT OF CATEGORY 2 ACTIVITIES – PORTABLE AND PERMANENT COUNTS

The objective of Category 2 activities is to document the success and challenges associated with the practices of the agencies that use internal or external resources for portable manual counts and permanent volume counts, classification counts, speed measurements, and weight measurements.

7.1 Description of TMS Sensor and Equipment Installation Services

The activities included as a part of Category 2 in this effort are:

- Portable manual counts (video, in-person, or electro-mechanical)
- Volume counts, classification counts, speed measurements (intrusive and non-intrusive)
- Weight measurements (through permanent or portable WIM)

7.2 Agency Resourcing Profiles

As discussed in the previous sections, a set of criteria was used in profiling the agencies and determining the alignment of their experience, practices, and resourcing profile with the objectives of this project. **Table 7-1** includes a list of agencies that were selected for interviewing, along with their profiles that were used in selecting those agencies.

Table 7-1. List of Agencies that were selected for Category 2 Interviews and Their Resourcing Profiles

Agency	State	Category 2 Portable and Permanent Counts			
		Portable manual counts	Volume counts, classification counts, speed measurements	Weight measurements	Other
California DOT	CA	FI	FI	FI	
Connecticut DOT	CT	FI	FI	FI	
Maryland DOT	MD	FO	MO	FI	
Missouri DOT	MO	FI	FI	FI	
New Jersey DOT	NJ	FO	MI	FI	
Ohio DOT	OH	FO	FO	FO	
Tennessee DOT	TN	FO	MI	FI	FI
Virginia DOT	VA	MO	MO	MO	
Central Massachusetts Regional Planning Commission	MA	FI	FI	FI	
Kern Council of Governments	CA	FO	FO		
Maricopa Association of Governments	AZ	FO	FO		MO
Thurston County Public Works	WA	MO	MO		

KEY

FO Fully Outsourced

MO Mostly Outsourced

MI Mostly Insourced

FI Fully Insourced

N/A

7.3 Agency Interviews and Evaluation of Responses

The following sections list the questions as they were asked to the interviewees, and summarize the categorized responses and discussions. The responses were summarized to only a select number of key interview questions. The responses provided a variety of the issues and challenges faced by the agencies, as well as experiences and solutions to those challenges and barriers identified by the state DOT, MPO,

and local agency personnel that are involved in the administrative and technical aspects of traffic data collection.

7.3.1 Interview Questions

The interviews for Category 2 included eleven questions and one discussion question grouped under the following four categories:

- Organizational Practices
- Decision-Making Processes
- Quality Assurance/Quality Control (QA/QC)
- Proposed Processes (discussion question)

Organizational Practices

1. You indicated that your agency in/outsources data collection activities.
 - a. How many years have you been in/outsourcing the data collection activities?
 - b. What are the benefits of in/outsourcing of the data collection activities?
 - c. Do you have documented procedures for data collection (regardless of who collects it)?
 - d. Did you ever compare the data quality for the periods when the data collection process was in- or outsourced (i.e., before-after comparison)? If yes, what were your findings/observations?
2. You indicated that your agency in/outsources data processing activities.
 - a. How long have you been in/outsourcing the data processing activities?
 - b. If your agency also in/outsources its data processing activities, is the data collection and processing consultants the same?
 - c. What are the benefits of in/outsourcing of the data processing activities?
 - d. How do you control the data quality?
 - e. Do you have documented procedures for data processing (i.e., formatting, imputing, and extrapolating)?
 - f. Did you ever compare the data quality for the periods when the process was in- or outsourced (i.e., before-after comparison)? If yes, what were your findings/observations?
3. You indicated that your agency is currently in/outsourcing most of its TMS activities even though your agency possess the necessary technical capabilities to manage TMS activities in-house.
 - a. Can you give some insight about the reasons why your agency decided to outsource TMS activities?
 - b. If you have experience with both in- and outsourcing, do you believe outsourcing TMS activities improves quality, lowers quality, or is about the same when compared to insourcing?
 - c. Are there any barriers that prevent your TMS activities from being completed in-house?
 - d. Please define the barriers that you already identified. Did you ever take actions to overcome the identified barriers? What were those actions?
4. Your agency temporarily suspends data collection activities during certain months or periods.
 - a. Which types of data collection activities are suspended?
 - b. What is the duration of the temporary suspension for each type of activity?
 - c. How long has this process been in place and what was the rationale behind it?
 - d. What are the benefits of the temporary suspension?
5. Your agency relies on on-site consultants for data collection or processing.
 - a. Can you describe your agency's experience with the process?

- b. Do you see having the on-site consultants for data collection and processing beneficial to your agency?

Decision-Making Processes

6. Your agency has a defined process for decisions regarding [outsourcing/insourcing] of the TMS activities.
 - a. Can you briefly describe this process?
 - b. Is it formalized? Is the process documented?
 - c. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties.)
 - d. Does this process work well for your agency?
 - e. How could it be improved?
 - f. How long has your agency been using this procedure?
 - g. Has it undergone any recent changes? If so, why?
 - h. How does your agency evaluate the advantages/disadvantages of outsourcing versus insourcing?
 - i. In a perfect world, how would this process be handled?
 - j. Who makes the final decision in this process?
 - k. How often, or what, would cause this decision to be reevaluated?
 - l. What would you change in the current process to make improvements?

Quality Assurance/Quality Control (QA/QC)

7. Your agency keeps track of the reliability measures of continuous count stations (CCS).
 - a. Can you briefly describe this process?
 - b. What do the reliability measures cover (speed, volume, classification)?
 - c. How detailed are the measures (e.g., is the lane-by-lane percentage of availability recorded in an automated system)?
 - d. How is reliability measured? Is the system comparing the data to the historical data of the same detector zone or lane readings, or is the data compared to upstream and downstream detector data with an algorithm that balances the volume between the detectors?
 - e. What were/are the challenges with developing/tracking these measures?
 - f. What are the benefits of having reliability measures?
 - g. What would you change in the current process to make improvements?
8. Your agency has a policy to inspect consultant equipment, installation, and data processing facilities/equipment on the site or in the field.
 - a. Can you briefly describe this process?
 - b. What are the most common types of field inspections?
 - c. Are the inspection procedures documented in the individual contracts or does the agency have documented regulations for such inspections?
 - d. What is the target number of inspections? How was that number determined? Do you achieve the target on an annual basis?
 - e. What are the challenges associated with the inspection process?
 - f. What are the benefits of the process?
 - g. What would you change in the current equipment inspection process to make improvements?
9. Does your agency have a warranty policy for installation of the CCS and associated traffic monitoring equipment/sensors?
 - a. If yes, how many years does the warranty typically cover?

- b. Do you see it beneficial to have a warranty policy and what are the benefits of having a warranty policy in place?
10. Does your agency have a policy to reimburse consultants for material purchased for counts requiring pneumatic tubes, clamps, securing devices, etc.?
- a. If yes, what is the typical method for reimbursement?
 - b. Is the cost of materials included in the contracts with the consultants or is the cost treated as an extra cost item in addition to the contract value?
11. Does your agency have documented requirements/processes for QA/QC for your TMS activities?
- a. Can you briefly describe those requirements/processes?
 - b. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties)
 - c. Do you see it beneficial to have a documented QA/QC policy? If yes, what are the benefits?
 - d. What would you change in the current QA/QC process to improve it or make it more effective/efficient?

Proposed Processes

The objective of the ‘Proposed Processes’ section was to gather information for use in the development of processes/matrices as part of the research recommendations. The agencies that provided substantial input for this section could be contacted once more after the recommendations were drafted. This section of the interview involved open discussions regarding specific agency experiences associated with the processes based on the resourcing type of the agency, lessons learned from past programs/practices, and feedback on potential processes presented by the research team. Examples of the latter include suggestions for process improvement measures, a decision-making process that could work for your agency (proposed but has not been implemented due a specific reason), or a process that you tried and refined after many iterations.

7.3.2 Summary of Interview Discussions

The following sections summarize the responses and discussion items. Please note that the annotation “not applicable” indicates that the agency did not have any activities that are applicable to the topic discussed in a particular question/sub-question, or the responding agency did not have information regarding the question being asked.

Organizational Practices

Question 1b: What are the benefits of in/outsourcing of the data collection activities?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Outsourcing requires little / less training for the DOT staff. This is especially important because performance is not affected by the turnover of the DOT staff. In addition, contractors are experienced and “hit the ground running.” From the equipment side, inventory and the requirement to maintain the equipment are diminished. “We set up the contracts, give them the schedule and they begin on the day we ask them to start. It is time savings as well as monetary savings. Feels that quality control is better.”
Kern COG	Fully Outsourced	Consultants do these counts all the time; therefore, they have the necessary experience and knowledge. The agency also receives more information than they could if they were to insource the count activities.
Maricopa AoG	Fully Outsourced	Outsourcing is beneficial for the activities that require special permits or equipment that the agency does not have the in-house technical capability to perform.
Maryland DOT	Mostly Outsourced	Allows for better control of the data. Outsourcing requires clear communication with contractors so that “nothing gets lost in the translation.” Other benefits for outsourcing are no equipment overhead, reduced staff size, and increased accuracy and efficiency.
Virginia DOT	Mostly Outsourced	The benefit of outsourcing is that it works much better to have contract staff that is focused on the activities instead of borrowed staff from within the agency. Outsourcing is used on the state-maintained roads and along the interstates. The state is responsible for the county road system in Virginia and VDOT district staff performs the counts on county roads using in-house resources.
Thurston County	Mostly Outsourced	Outsourcing saves wear and tear on employees and allows them the time to perform other activities. In addition, the process of getting the counts is much faster when outsourced (compared to spreading it out to several months when insourced). However, customer-driven requested counts are done in-house.
New Jersey DOT	Mostly Insourced	NJDOT outsources their portable count activities for the past several years, because it is more flexible for the agency operations. Outsourcing has a better public perception, given the assumption that contractors cost less money than having agency staff. However, the agency prefers to insource the data processing, because it provides better control and the investment for training in-house staff is a better than training on-site consultants (turnover).

Question 1b (continued): What are the benefits of in/outsourcing of the data collection activities?		
Agency	Resourcing	Response
Tennessee DOT	Mostly Insourced	In-house counts save money because the agency has the control to reduce consultant fees. It is easier to control data quality. It is easier to track whether counts are on time or behind schedule.
California DOT	Fully Insourced	CalTrans has a better knowledge of the actual volumes/classification distribution along the state roadways. The district office staff lives and works in the area, so they are familiar with the traffic patterns and know their equipment. This helps the validation process. It is clear for quality control and analysis.
Connecticut DOT	Fully Insourced	The agency has better knowledge of the data and can control the quality better.
Missouri DOT	Fully Insourced	Driving factor is cost. Contractors can do counts on short notices, but in-house staff is knowledgeable/works well.
CMRPC	Fully Insourced	The agency does not have annual contracts with third party consultants. The data collection program is managed in-house by the agency staff, but the data collection is usually performed by college students. Assigning the field activities to college students is more cost-efficient than having full-time staff members performing the counts.

The interviewees identified the following as the benefits of insourcing or outsourcing portable and/or permanent counts:

Insourcing

- Insourcing can be beneficial for data validation by using the local knowledge of the staff about the traffic volumes and vehicle classifications along the roadways where they live
- Agency staff has institutional knowledge of the historical data trends, thus QC is more effective
- Agency has better control on schedules and timeliness of the counts
- More cost-efficient when compared to outsourcing (not necessarily documented by the agencies)
- Allows for creative approaches such as managing the data collection program in-house but contracting the data collection activities to college students, which is more cost-effective than outsourcing to contractors
- Allows flexibility for the agency to outsource certain activities, but keep other activities for in-house capabilities, thus taking advantage of the benefits associated with both practices

Outsourcing

- Reduces safety concerns among the agency’s staff members
- Necessary when no in-house capability exists (equipment or technical knowhow)
- Consultants regularly perform counts and have the necessary experience and skill set
- Provides flexibility in budget control, scheduling, or suspending the counts
- Condenses the count season
- No need to keep an inventory of or maintaining equipment, thus no equipment overhead
- Increased accuracy of the data (not necessarily based on formal comparison or analyses)

Question 1d: Did you ever compare the data quality for the periods when the data collection process was in- or outsourced (i.e., before-after comparison)? If yes, what were your findings/observations?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Had the opportunity to compare the 3-year data collected by insourced and outsourced practices. However, the comparison yielded to no significant differences in the data and there was no specific conclusion. Checks are based on historical data, but there is no guarantee that the historical data is correct. If anything, data quality and integrity seem to have improved, as consultants know how to collect data properly.
Kern COG	Fully Outsourced	The agency is getting a lot more categories of data with outsourcing.
Maricopa AoG	Fully Outsourced	Contracts are written in a fashion where the contractors perform their own QA/QC. The agency is “heavily” involved from beginning to end. The agency has QA/QC requirements for every type of data collection.
Maryland DOT	Mostly Outsourced	Not formally compared, but the overall data quality has greatly improved since the traffic monitoring program was transferred to our office.
Virginia DOT	Mostly Outsourced	No, prior to using contractors, the agency did not focus as much on data quality and there is no direct comparison. The quality before and after outsourcing might have been the same quality if the state had dedicated staff and sufficient resources for conducting counts.
Thurston County	Mostly Outsourced	Only informally, noting that quality is about the same as if it was done in-house.
New Jersey DOT	Mostly Insourced	Yes, the quality of data depends on the vendor, but with new validation processes in place, no real difference in data quality before and after outsourcing (portable counts). The quality of the data collected at the permanent stations is monitored closely by using an automated system, thus a comparison of before/after is not available.
Tennessee DOT	Mostly Insourced	It was 3-4 times more expensive to outsource. Few other differences were noted in the data, but those differences reflected more variation in consultant data. Therefore, data quality is better when insourced.
California DOT	Fully Insourced	Based on experience of other CalTrans departments/groups, the data quality would not be as good if it were outsourced.
Connecticut DOT	Fully Insourced	No Response/Not Applicable
Missouri DOT	Fully Insourced	The agency had part-time employees and had to let them go when the workload became “light.” No difference in performance from part-time and full-time staff as they all receive the same training.
CMRPC	Fully Insourced	Full-time staff members typically do a better job than college students do, but college students are a lot less expensive and the quality of data appears to be acceptable.

There was no discernable consensus on the quality of count data that are collected through in-house staff or consultants. Nearly every agency indicated that their current resourcing practices were as good or better when compared to the counts collected utilizing an alternative resourcing practice. Since many of the agencies did not undertake a study to compare and document the quality of data using either resourcing practice, the research team could not identify if the data quality of one method was superior. Many of the agencies have experience only with one type of resourcing practice (either in- or outsourcing) and are therefore unable to compare the data quality for the method that is not used.

Question 2c: What are the benefits of in/outsourcing of the data processing activities?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Ohio DOT deployed MS2™ ¹³ data management and analytics software package. With MS2™, everything is combined into one system, versus 3-4 programs that were once used to process counts. It is beneficial for everyone in the office to know the same system so everybody can help everybody else, and those familiar with all the sites can do the checks to give the final approval.
Kern COG	Fully Outsourced	The automatic error checking is better than eyeballing and the agency gets nice reports and bar charts.
Maricopa AoG	Fully Outsourced	Lack of resources to do processing in-house.
Maryland DOT	Mostly Outsourced	Better quality control, task/consultant tracking is easier, greater percentage of met deadlines.
Virginia DOT	Mostly Outsourced	A very talented IT person is on staff who knows business and programming needs, but a lot can be lost in translation between IT and business.
Thurston County	Mostly Outsourced	Currently, staff import all electronic data (regardless of the source) into a County database. This provides a good opportunity to check data quality.
New Jersey DOT	Mostly Insourced	Doing data processing in-house allows the agency to monitor data and verify its quality, to identify a problem with monitors or sensors if equipment malfunctions.
Tennessee DOT	Mostly Insourced	Better control of and confidence in the data and knowing what the agency plans to do with the data allows them to manipulate the data as needed. Outsourced for some areas that were deemed too dangerous for in-house staff until permanent counters were installed.
California DOT	Fully Insourced	The same people who install equipment validate data so problems can be identified quickly.
Connecticut DOT	Fully Insourced	The agency has a better handle on what is going on at each site based on historical data.
Missouri DOT	Fully Insourced	When the previous consultant for data clearinghouse went out of business, the agency was able to perform normally.
CMRPC	Fully Insourced	In-house staff has more knowledge; therefore, the agency has better control of the data.

¹³ MS2 is a registered trademark of a traffic analytics software (<http://www.ms2soft.com/>)

The interviewees identified the following as benefits of insourcing or outsourcing data processing activities:

Insourcing

- Having the same staff do counts and processing helps the agency to identify issues quickly
- In-house staff are more familiar with area roadways and counts
- Allows for seamless continuity if an external data processing contractor is not available (e.g., goes out of business)
- Flexibility in data manipulation to fit agency's specific needs (e.g., planning, forecasting, precision levels)
- More confidence in the data because of staff knowledge of the historical trends
- Interdepartmental communication for IT support, data collection, and data processing could be problematic

Outsourcing

- All of the data collection and processing is handled within a single system; therefore, everyone in the department uses one system, thus reducing the need for external help when needed
- Reduces staffing requirements
- Provides flexibility for risk aversion by outsourcing activities that pose safety concerns for the field personnel, but keeping less-risky activities for in-house staff
- Interdepartmental communication between the IT support, business units, data collection/processing could be problematic
- Greater percentage of met deadlines.

Question 3 c and 3d: Are there any barriers that prevent your TMS activities from being completed in-house? Please define the barriers that you already identified. Did you ever take actions to overcome the identified barriers? What were those actions?

Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	When the Ohio DOT decided to outsource it was determined that all those district resources would be pushed back to handle core district functions. Lost resources to do count data so that is when the agency decided to outsource. Being able to staff back up internally has been requested, but not provided. Over the years, the agency had the availability to purchase and maintain equipment, but there is no staff to go out and set the units. A cost evaluation was prepared and submitted to executive management.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	For traffic counts in this region, even if the agency had resources, it would not make sense to do data collection, because the agency employs consultants only for relatively short periods of time throughout the year, and not even every year. Therefore, it makes more sense to rely on consultants. There are a few counties who do their own counts and the Arizona DOT does counts using in-house staff. However, that is the only task they have and it works for them. Even if the Maricopa AoG had the staff capabilities, the traffic data collection would be outsourced for efficiency purposes.
Maryland DOT	Mostly Outsourced	Lack of personnel, equipment, and technical capabilities are the barriers for insourcing. Currently, Maryland DOT does not have in-house capabilities to perform the data collection tasks. In addition, the agency strongly believes that it is unlikely that they will regain the process of performing the activities in-house. However, they use the contracting mechanisms to have additional staff on an as-needed basis as on-site consultants.
Virginia DOT	Mostly Outsourced	If the agency had the work force in-house it would be just the same as when it is outsourced. VDOT does not see any barriers for insourcing the TMS activities. Funding is not an issue. The practice of outsourcing is based on the agency's decision to outsource these activities a long time ago.
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	Not Applicable
Tennessee DOT	Mostly Insourced	Not Applicable
California DOT	Fully Insourced	Not Applicable
Connecticut DOT	Fully Insourced	Not Applicable
Missouri DOT	Fully Insourced	Not Applicable
CMRPC	Fully Insourced	Not Applicable

Based on the responses from the agencies, it is difficult to conclude a clear reason behind their outsourcing decisions, except the flexibility that comes with outsourcing versus full-time staff, especially for the states that have legislative actions regarding staff reduction or hiring freezes. In the Ohio DOT's case, the agency also indicated that they had invested in the purchase of equipment and technology, but staffing became a major barrier, thus they decided to outsource the data collection activities.

Question 4a: If you temporarily suspend data collection efforts, which types of data collection activities are suspended?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Short-term counts are suspended December through March.
Kern COG	Fully Outsourced	Counts are suspended when school is out and during irregular traffic patterns. These normal traffic patterns resume in January.
Maricopa AoG	Fully Outsourced	The counts are driven by necessity. Not much data is collected on weekends and data is collected on weekdays in between March/April and November.
Maryland DOT	Mostly Outsourced	Coverage counts are not done during snow or during the holidays. Holiday counts are collected at specific locations where the traffic data at those locations are important for the analysts. Special counts for traffic studies and other planning/engineering projects are collected year round, except extreme weather conditions.
Virginia DOT	Mostly Outsourced	Short-term counts are not collected on Friday, Saturday, or Sunday, during holiday periods, special events (e.g., NASCAR race), snowstorms, or anything that would cause abnormal traffic patterns.
Thurston County	Mostly Outsourced	No scheduled counts from December to February because salt and sand on roads can affect counters and plow trucks can destroy tubes.
New Jersey DOT	Mostly Insourced	Short-term counts are suspended during Thanksgiving weekend and from December 15th to January 2nd. Fewer counts are done in January and February due to weather.
Tennessee DOT	Mostly Insourced	Portable and permanent counts are conducted year-round, regardless of weather conditions/events.
California DOT	Fully Insourced	48-hour counts are suspended on weekends and during Daylight Savings Time changes.
Connecticut DOT	Fully Insourced	All WIM and most classification counts are suspended in winter. New equipment will extend counts season. CCS count year-round.
Missouri DOT	Fully Insourced	Do not do counts if it is snowing but will still count in January if no snow. The agency does not install roadside sensors until March/April due to weather sensitivities.
CMRPC	Fully Insourced	Short term counts are performed from April to November and the agency stops when snow starts to fall.

Unsurprisingly, the majority of agencies stated that the short-term data collection activities are suspended for the following periods:

- Major holiday weeks (e.g., Thanksgiving, Christmas)
- Holiday period when schools are not in session (typically from December 15th until the second week of January)
- Winter months (typically from November until March/April)

- Special events (e.g., sporting events, and conferences)

Tennessee DOT was an exception, where they indicated that their permanent and portable count activities are year round regardless of weather conditions. Alternatively, the agencies also indicated that the continuous count stations (CCS) collect traffic data year round.

Question 4d: What are the benefits of the temporary suspension of data collection activities?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	It formalizes the process. It allows the DOT to have time to prepare and develop the schedules for the upcoming year.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	No Response/Not Applicable
Maryland DOT	Mostly Outsourced	Averages are not skewed by exceptional or abnormal travel days.
Virginia DOT	Mostly Outsourced	The agency might call for a temporary suspension if any unsafe practices by a consultant are noticed.
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	Weather impacts traffic significantly, so the data is not reliable. Tubes are damaged by snow removal and lose accessories can be a hazard for cars.
Tennessee DOT	Mostly Insourced	No Response/Not Applicable
California DOT	Fully Insourced	No Response/Not Applicable
Connecticut DOT	Fully Insourced	No reason to collect something you know will not be good quality.
Missouri DOT	Fully Insourced	Prevents data from being compromised.
CMRPC	Fully Insourced	Agency uses this time to put together summary booklet of data and organize for next year.

The interviewees identified the following as the benefits of temporarily suspending counts:

- Data will not be representative of normal conditions, thus the annual or other averages will be skewed
- Traffic volumes and vehicle classification data will not be representative of regular conditions because traffic patterns are significantly altered during unusual weather conditions
- Tubes and equipment will be damaged by snow removal activities
- Tubes and equipment will be removed from their secured locations, thus creating a hazard for the traveling motorists
- Temporary suspension allows for a “break” for the agencies so that they can schedule and prepare for the upcoming data collection activities
- The “break” serves as an opportunity for the agencies to process the collected data, summarize the results or prepare reports, and evaluate any unusual patterns in the data

Decision-Making Processes

Question 6a and b: Can you briefly describe your agency’s process for decisions regarding insourcing/outsourcing of TMS activities? Is it formalized? Is the process documented?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	There were pros and cons to both, such as funding and staffing levels. All information was documented at that time (not formalized) and made available to upper management for their decision-making. The ultimate decision was made by the upper management.
Kern COG	Fully Outsourced	“There is no discussion. We outsource everything.”
Maricopa AoG	Fully Outsourced	Cannot perform all the needed counts in-house due to the cost associated with them. “In the future, buying data will be the way to go.”
Maryland DOT	Mostly Outsourced	When the TMS program was moved to this office, the program was structured to outsource portable/manual counts and construction of permanent counting stations. After construction, the permanent counting stations are insourced. The decision-making hierarchy is formalized within the office structure.
Virginia DOT	Mostly Outsourced	There is no defined process, but the initial decision was likely informed by a cost/benefit analysis (a long time ago).
Thurston County	Mostly Outsourced	No documented process but would be valuable to have.
New Jersey DOT	Mostly Insourced	Decisions are made at the management level based on each bureau's needs and funding. If there is a need, available funding will be reviewed, and a decision will be made. The information to support the decision is provided to the management by the technical staff that is involved in the program.
Tennessee DOT	Mostly Insourced	There is no formal process. It is discussed within the department and taken to the upper management. The decision-making process depends on how many counts the agency has, how far behind they are, and is evaluated on a year-to-year basis, not based on a formal plan or process.
California DOT	Fully Insourced	The decision is up at the governor’s office level so the policies depend on the governor’s office.
Connecticut DOT	Fully Insourced	This has always been the practice of the agency. The decision-making process could have been formalized, but it has not been done so far and there is no real documentation. There are general directions about the process, but no specific procedures about “when” or “why.”

Question 6a and b (continued): Can you briefly describe your agency’s process for decisions regarding insourcing/outsourcing of TMS activities? Is it formalized? Is the process documented?

Agency	Resourcing	Response
Missouri DOT	Fully Insourced	Executive management has empowered transportation planning to provide the best quality data that is possible, while adhering to Federal guidelines. Therefore, the decisions for the traffic data collection activities are made by the people at administrator and manager levels, and the decision is reported to the department head. The team gathers ideas, and if there is a feasible solution, the idea is submitted to the manager, who has a background in TMS and programming. Generally, the decision process is need-based rather than a documented and formalized process.
CMRPC	Fully Insourced	No real process as there is no need to outsource the activities, as long as the agency can continue hiring college students.

The majority of interviewed agencies did not have a documented (or defined) decision-making process in place for their portable and permanent count resourcing practices. Many agencies indicated that when the initial decisions for their resourcing practices were made, a cost/benefit analysis was likely undertaken but no further action or documentation took place later. The research team observed that the resourcing practices were deeply ingrained within the agency and very little is being done to re-evaluate needs or re-assess changing conditions.

Minor decisions of a maintenance nature, such as contract modifications or changes in consultant’s procedures, are mostly handled within the department responsible for the traffic data collection programs; however, decisions involving changes to current practice are made at a higher management level. In summary, none of the agencies that responded to the assessment questions or interview questions could identify a formalized and properly documented decision-making process or drafted procedures. Many agencies mentioned an informal benefit/cost analysis or cost evaluations, but the same agencies indicated that such analyses or evaluations were undertaken a while ago and have not be re-visited.

Question 6e: How could your current decision making process be improved?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Not sure, but there is also no “good answer” for this, because decision-making processes are very agency specific. The process could be reviewed more often or periodically if it was incorporated as a part of the program. Reevaluation of the program and operations could be set as a goal for the decision-makers.
Kern COG	Fully Outsourced	Works well as is. “We get a lot more bang for the buck this way and cannot foresee anything changing this.”
Maricopa AoG	Fully Outsourced	No Response/Not Applicable
Maryland DOT	Mostly Outsourced	Everything but quality control and data validations could be outsourced.
Virginia DOT	Mostly Outsourced	No Response/Not Applicable
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	Having more staff. Currently developing applications for staff to have more time for validation. Having stable funding from FHWA is better so the department can plan ahead. Staffing levels are decided by the governor’s office and could be more practical if the department was more involved in the decision-making processes.
Tennessee DOT	Mostly Insourced	Not sure.
California DOT	Fully Insourced	Work being done in-house is excellent, might be room for improvement but skeptical of outsourcing.
Connecticut DOT	Fully Insourced	No Response/Not Applicable.
Missouri DOT	Fully Insourced	Currently working to improve counts. There is a continual/routine quality improvement process and nothing stands out as needing an immediate fixing.
CMRPC	Fully Insourced	No Response/Not Applicable

Question 6j: Who makes the final decision in your agency’s decision-making process?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Executive managers.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	If approved in-house, the decisions go to Regional Council. Never too much resistance unless it is new or unusual.
Maryland DOT	Mostly Outsourced	Division management.
Virginia DOT	Mostly Outsourced	No Response/Not Applicable
Thurston County	Mostly Outsourced	The County Traffic Engineer. Annual budget is approved by county commissioners.
New Jersey DOT	Mostly Insourced	The decision process includes multiple sub processes and has multiple stakeholders. The annual plan goes to the Assistant Commissioner and the planning entities in NJ. Funding is decided between FHWA, planning entities, and NJDOT.
Tennessee DOT	Mostly Insourced	No Response/Not Applicable
California DOT	Fully Insourced	Governor's office.
Connecticut DOT	Fully Insourced	Immediate supervisor. The decision then goes up through management.
Missouri DOT	Fully Insourced	Department administrator and manager reports to department head.
CMRPC	Fully Insourced	Transportation manager or director.

The majority of interviewed agencies indicated that the final decision for their resourcing practices were or would be made by someone at a higher management level, all the way up to the governor’s office. The research team observed that decisions that involve system “adjustments” are made at the technical manager or supervisor levels. However, major decisions such as changes to the program funding or resourcing practices are made either collaboratively by several department heads and executive management or solely by the upper/executive management.

Question 6I: What would you change in the current decision making process to make improvements?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Upper management makes any executive decision, but would have a lot more flexibility if it were contained within the agency with the technical expertise.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	Want to make sure the public's money is being spent as well as possible and there is a reason things are set up the way they are.
Maryland DOT	Mostly Outsourced	Not sure.
Virginia DOT	Mostly Outsourced	No Response/Not Applicable
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	NJDOT's scope of work is prepared according to the deadlines given, but the speed of approval is out of NJDOT's control.
Tennessee DOT	Mostly Insourced	No Response/Not Applicable
California DOT	Fully Insourced	No Response/Not Applicable
Connecticut DOT	Fully Insourced	Add more staff.
Missouri DOT	Fully Insourced	More money and personnel in the field. Another office staff to process data.
CMRPC	Fully Insourced	No Response/Not Applicable

Quality Assurance/Quality Control (QA/QC)

Question 7a: Your agency keeps track of the reliability measures of continuous count stations (CCS). Can you briefly describe this process?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Reliability measurement is done as it is processed with QA checks within the system.
Kern COG	Fully Outsourced	Website automatically checks quality for Bakersfield's CCS.
Maricopa AoG	Fully Outsourced	Staff checks locations and there is only a certain amount of data being collected at one time. Occasionally, the agency staff checks the set-ups by performing brief manual validation counts. If there is an issue (discrepancy) in a count, the contractor is required to re-count.
Maryland DOT	Mostly Outsourced	Staff checks data location from GPS points on boxes and makes sure format is correct. Counts are downloaded daily and are subjected to a set of stored validations, then to an evaluation by staff on a daily, monthly, and annual basis.
Virginia DOT	Mostly Outsourced	Tools are used to graph performance over time, including a classification tool with 21 bins, so the agency can watch as an unclassified vehicle starts to build, and missed axels can be placed in the proper classification bin.
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	There are multiple checkpoints. During the regular data downloading process, the agency can check that the site is operational; whoever accesses WIM station data can verify that the sensors provided the proper classification and weight reading.
Tennessee DOT	Mostly Insourced	Not formalized. The processing program gives a visual idea about count stations that are not accurate by assigning a different color.
California DOT	Fully Insourced	Staff in 12 districts does most of the QA.
Connecticut DOT	Fully Insourced	Being a [relatively] small state, the agency staff knows "what is going on and where." The data are checked frequently.
Missouri DOT	Fully Insourced	Annual verification and adjustments as needed.
CMRPC	Fully Insourced	No Response/Not Applicable

Work execution methods, and measuring/documenting reliability were expected to be different for each agency due to reasons that included variances in coverage area, technical capabilities of the system, equipment capabilities, and communication technologies. The reliability checks can be as complex and customized as daily validation of lane-by-lane volume, speed, and classification data by using historical trends or as simplified as using the vendor-supplied software graphs. Except for a few agencies that rely on manual QA/QC methods, as the industry moves toward the use of software and automation of the data validation activities, it was observed that agencies are supporting the idea of customized software applications that perform reliability validation at multiple checkpoints, regardless of in- or outsourcing of the data collection or processing activities.

Question 7d: How is the reliability of you CCS measured?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	The current process relies on checks against historical data.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	No Response/Not Applicable
Maryland DOT	Mostly Outsourced	Reliability is measured by both comparing the data to the historical data of the same detector and up and down stream counters/sensors.
Virginia DOT	Mostly Outsourced	Volume is measured against the historical AADT every day and must fall within a certain range (upstream/downstream comparisons can be done manually, if needed); if classification is good, the agency considers speed data to be good.
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	The agency sticks to the basics to make sure the data are accurate.
Tennessee DOT	Mostly Insourced	No Response/Not Applicable
California DOT	Fully Insourced	Some of it is automated and each district has a different way of validating data.
Connecticut DOT	Fully Insourced	Compared manually to historical data.
Missouri DOT	Fully Insourced	Compare two years of monthly data to current month and compare up/down stream.
CMRPC	Fully Insourced	No Response/Not Applicable

Briefly stated, the consensus by the agencies was that historical data are the most frequently used source for reliability checks and data validation. However, as stated by the Ohio DOT as a response to Question #1d, there is no “guarantee” that the historical data are reliable to be used as a source. Reliability measurement is an evolving topic and there are many concepts being developed through research venues to enhance the reliability measures of data.

Question 7e: What were/are the challenges with developing/tracking these reliability measures?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	No specific challenges. Since currently migrating to a new system, developing something that can be utilized and understood by the staff, and is doable in their limited amount of time is the challenge. Ohio DOT's biggest challenge is having systems that can run data, store data, and have checks in place, as well as the people to do the checks.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	No Response/Not Applicable
Maryland DOT	Mostly Outsourced	Compiling site-specific information/attributes for the large number of locations to be counted.
Virginia DOT	Mostly Outsourced	Labor and the time to review it.
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	The agency had to build the database and then consider analytical tools.
Tennessee DOT	Mostly Insourced	Having stations consistently responding the same way; sometimes the computers cannot connect to the counters. Currently converting landline phones to IP phones, but the cost is a big factor.
California DOT	Fully Insourced	No Response/Not Applicable
Connecticut DOT	Fully Insourced	The process is okay
Missouri DOT	Fully Insourced	Field crew monitors all sites. One office staff monitors data and monthly Federal submittals.
CMRPC	Fully Insourced	No Response/Not Applicable

Just as there are different methods employed for reliability measurement, the challenges with regard to reliability measurement also varied by agency. Despite this, one common theme was that challenges are faced in building the reliability tracking system and developing the databases of historical counts that will be used in reliability checks. Staff time and costs (internal or contract costs) are the direct challenges associated with building up such databases. In addition, it was reported that while reliability checks were performed or monitored by the in-house staff, the actual software used to perform the reliability measurement is developed and deployed by a third-party vendor. Another noteworthy observation was that none of the interviewed agencies attempted to develop their software using in-house capabilities and they primarily rely on the contractors to perform the development, testing, and calibration of the software systems. Benefits of this include vendor expertise, cost-efficiency of customizing a system that was already implemented and tested elsewhere, and continuous technical support.

Question 7g: What would you change in the current CCS reliability measure process to make improvements?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Would not automate system completely, because some oversight is needed. Currently modifying the data mining process to adjust QC checks by site, which will provide a tool to make adjustments by site.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	No Response/Not Applicable
Maryland DOT	Mostly Outsourced	Site-specific characteristics would be included in the data validation process.
Virginia DOT	Mostly Outsourced	No Response/Not Applicable
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	NJDOT does not control the database; ideally, the agency would build and control a database in-house so that a contract could be issued to better analyze the data. The ability for NJDOT to sell their data to other stakeholders, and allow other to make their own queries.
Tennessee DOT	Mostly Insourced	The agency is limited to one particular software to download, store, and process data, but it is cumbersome for data manipulation.
California DOT	Fully Insourced	More automation, funding, and resources. Lots of software, not sure “what can do what.”
Connecticut DOT	Fully Insourced	“Nothing besides staffing and technology limitations.”
Missouri DOT	Fully Insourced	The agency would like to have concrete pavement at every site to increase the durability of the sensors installed in the pavement.
CMRPC	Fully Insourced	No Response/Not Applicable

The responses to this question, again, validated the difference in the agencies’ needs and approaches. For example, Ohio DOT specifically emphasized “to not fully automate” the system checks, but California DOT emphasized the need for “more automation” of their system.

Question 8d: Your agency has a policy to inspect consultant equipment, installation, and data processing facilities/equipment on the site or in the field. What is the target number of inspections? How was that number determined? Do you achieve the target on an annual basis?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	For CCS, a 100% target, and the only reason someone would not be present is because the agency ran out of staff. For short-term counts, inspections are random, and there is no set target number. Consultants must provide four photos of each station setup.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	If not all, then most. Inspectors will select sites as checkups. Can detect most issues just by evaluating the data.
Maryland DOT	Mostly Outsourced	Everything would be done in-house if it were possible (i.e., personnel availability). Should not target 100% inspections as the agency has to trust consultants or there is a risk of losing them. Inspections are random and district offices know when and where counts are occurring.
Virginia DOT	Mostly Outsourced	For CCS, a 100% target is achieved every year. All short-term count installations are documented, but only about 5% are inspected given limited resources. VDOT might not get to inspect all installations. Sometimes the agency may be only be able to look at an installation when something comes up in the data that indicates an issue.
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	There are no set rules for the number of inspections for the portable count stations, but a NJDOT inspector is present during permanent station installations.
Tennessee DOT	Mostly Insourced	No Response/Not Applicable
California DOT	Fully Insourced	No Response/Not Applicable
Connecticut DOT	Fully Insourced	All installations are inspected.
Missouri DOT	Fully Insourced	Every site is checked at least once a year.
CMRPC	Fully Insourced	No Response/Not Applicable

Although every agency has a different approach to the inspection of contractors' work, it was noticed that there are no set rules regarding the ratio of installations versus inspections. Random inspection of the portable count locations appears to be the common approach; however, the majority of the outsourcing agencies indicated that they have provisions in their contracts reserving the right to perform random inspections and reject any count data that resulted from an incorrect equipment set-up or the wrong location. The most interesting approach was mentioned by the Maryland DOT. In order to maintain a healthy relationship with their contractors, they prefer to maintain a balance between an adequate number of inspections and trusting their contractors to self-monitor. The agency believes that a level of trust must be exhibited towards its hired data collection contractors to save the time and expenses associated with checking each installation. The locations and dates of the portable counts are reported to the Maryland DOT's district offices ahead of time and the district personnel who live locally have the opportunity to monitor any installations randomly.

Question 8f: What are the benefits of this inspection process?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	On both portable and permanent, the inspectors are considered the “eyes” of the agency and develop a relationship with contractors. It is definitely a good practice to develop those relationships and make sure that the contractors are out there, to help them, and keep an eye on them.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	Staff is very good and can easily detect problems.
Maryland DOT	Mostly Outsourced	Improves the data quality.
Virginia DOT	Mostly Outsourced	Video makes it easy understand a problem when an issue arises.
Thurston County	Mostly Outsourced	No Response/Not Applicable
New Jersey DOT	Mostly Insourced	No Response/Not Applicable
Tennessee DOT	Mostly Insourced	No Response/Not Applicable
California DOT	Fully Insourced	No Response/Not Applicable
Connecticut DOT	Fully Insourced	“It just works okay.”
Missouri DOT	Fully Insourced	Helps to be proactive and stem any issues before they happen.
CMRPC	Fully Insourced	No Response/Not Applicable

There are two major benefits associated with inspecting the count stations of the agency or contractor installations. The first one is that it improves data quality. Contractors perform better if they know that their set-up can be inspected randomly and the agency staff is more proactive in monitoring their own equipment’s performance. The second benefit is the ability to detect problems early before daily or weekly data sets are transmitted to the office. This allows for immediate remediation to avoid erroneous data collection.

Question 11a: You indicated that your agency has defined QA/QC procedures. Can you briefly describe those requirements/processes?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	MS2™ documentation for QA/QC is used as a general procedure for the QA/QC process for the data.
Kern COG	Fully Outsourced	Using the system's built in sensitivities that compare against historical data.
Maricopa AoG	Fully Outsourced	No Response/Not Applicable
Maryland DOT	Mostly Outsourced	Catching all errors manually is difficult so the agency tries to automate as much as possible. The agency also uses stored procedures to validate the data during the loading procedure.
Virginia DOT	Mostly Outsourced	If the classification shows that greater than 5% is binned as “unclassified,” data need to be checked.
Thurston County	Mostly Outsourced	No process in place.
New Jersey DOT	Mostly Insourced	Not sure if there is formal QA/QC documentation. It is a need, but currently a low priority since NJDOT knows how to check and monitor data by relying on institutional knowledge and known traffic characteristics. For example, in general, the number of Class 3 vehicles has to be less than Class 2 vehicles, Class 9 should be less than Class 8, 75% of the data has to be for Classes 2 and 3, etc. In 2015, NJDOT began developing a new system that will incorporate validation rules based on the FHWA TMS and internal ones.
Tennessee DOT	Mostly Insourced	Not sure if a documented process exists. If tracking spreadsheets showing monthly and annual changes in traffic volume do not look right, then investigate what may have caused the change.
California DOT	Fully Insourced	Same as FHWA Traffic Monitoring Guide.
Connecticut DOT	Fully Insourced	None currently in place.
Missouri DOT	Fully Insourced	Have a guidelines and personnel handbook for installation. Checks in software and human verification.
CMRPC	Fully Insourced	No real documented procedures but currently writing a how to manual on some things.

Question 11c: Do you see it beneficial to have a documented QA/QC policy? If yes, what are the benefits?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Absolutely, particularly for staff turnover, warranty, and contract issues.
Kern COG	Fully Outsourced	No Response/Not Applicable
Maricopa AoG	Fully Outsourced	A Federal document that documents procedures would be helpful. Ensures contractors know the requirements.
Maryland DOT	Mostly Outsourced	Yes, it improves data quality.
Virginia DOT	Mostly Outsourced	Yes, it removes guesswork and having defined rules for what is acceptable makes it easy to check the data.
Thurston County	Mostly Outsourced	Value in having a policy in place for when staff turnovers occur.
New Jersey DOT	Mostly Insourced	No, a QA/QC manual would not be practical to replace training, as there are too many little things that would not be considered until you actually do the work. Annual changes would necessitate frequent manual revisions. Certain components of QA/QC cannot be written in computer language. The new application which NJDOT started developing in 2015 will contain a manual document with QA/QC rules.
Tennessee DOT	Mostly Insourced	Beneficial for having new staff understand the way that it is done and take over the collection, processing, and reporting.
California DOT	Fully Insourced	Yes, people would take advantage of process if it were documented.
Connecticut DOT	Fully Insourced	No Response/Not Applicable
Missouri DOT	Fully Insourced	Helps with on the job training for new employee.
CMRPC	Fully Insourced	No Response/Not Applicable

Interviewees largely supported having a documented QA/QC process. This process could help to prevent downtime and loss of knowledge during staff turnover, ensure that the processes in place were followed, remove all guesswork for data checks, and help in training new staff. Only one agency indicated that having a documented QA/QC process would not be beneficial for three main reasons. It could not replace its current QA/QC training process, frequent changes to the QA/QC process would also necessitate frequent changes and updates to the QA/QC manual, and certain QA/QC checks could not be written into computer code.

Question 11d: What would you change in the current QA/QC process to improve it or make it more effective/efficient?		
Agency	Resourcing	Response
Ohio DOT	Fully Outsourced	Looking at data mining to improve parameters for QC checks within data.
Kern COG	Fully Outsourced	“Nothing, it works very well and people like the data.”
Maricopa AoG	Fully Outsourced	Things would be different with more resources and staff time. Improvements are limited by staff time and consultant capabilities.
Maryland DOT	Mostly Outsourced	Add more automated rules to our existing set.
Virginia DOT	Mostly Outsourced	Nothing.
Thurston County	Mostly Outsourced	More guidance that includes a list of checks to make in the data when reviewing it, and procedures uploading the data into the system.
New Jersey DOT	Mostly Insourced	No Response/Not Applicable
Tennessee DOT	Mostly Insourced	Developing a documented QA/QC process that includes relevant definitions for what the agency is looking would be very helpful.
California DOT	Fully Insourced	Need more automation. Would be nice if FHWA had system to run data through before submitting.
Connecticut DOT	Fully Insourced	No Response/Not Applicable
Missouri DOT	Fully Insourced	Looking for tubes that do not come loose.
CMRPC	Fully Insourced	No Response/Not Applicable

7.4 Rationale for Agencies' Resourcing Practices for Portable and Permanent Counts

The majority of agencies that were interviewed are unable to provide an established and documented decision-making process for insourcing or outsourcing 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.

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.

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 twice, 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.

7.5 Experiences, Challenges, and Success Stories of Agencies for Portable and Permanent Counts

The decision to utilize current resourcing practices for portable and permanent counts was often made at a level of management that appeared to be less concerned with quality of the count program and more concerned with staffing levels and funding. Several agencies expressed that they are required to utilize contracts as a result of staffing and resource shortages. Relying more heavily on contracts as opposed to hiring additional in-house staff can often times be for the sake of optics and the perception of state spending. At the same time other agencies reasoned that insourcing count activities saves money and reduces the number of consultant contracts. Though a number of the agencies have strong opinions for which resourcing option is the least expensive, no clear strategy for evaluating the cost/benefit ratio of resourcing activities existed and the decision was more frequently a product of state politics.

Nearly every agency indicated that a documented QA/QC process either is currently beneficial or would be beneficial to the agency. Agencies feel that having a documented QA/QC process would lessen the impact of staff turnover, assist in staff training, and ensure that each staff member is following the same procedure, increasing the agency's confidence in its data.

7.6 Summary of Best Practices reflecting Cost and Time Efficiency, Effectiveness, and Reliability for Portable and Permanent Counts

Through the course of interviews with agencies in all categories, two separate agencies indicated that they have experienced success in utilizing college students for their short-term counts. Often hired during the summer months, these lower paid college students prevent these agencies from having to hire additional full-time staff members or establish contracts with consultants.

Many of the interviewed agencies who rely on consultants to complete their portable and permanent counts do so out of necessity. Often pressed by the constraints of state government in the form of budget and staff cuts, these agencies are forced to rely on consultants to complete their required counts. Agencies frequently indicated that outsourcing is simply the only option they can pursue if their counts are to be completed.

Best Practices - As discussed previously, the majority of the agencies listed “staffing reductions” or “hiring freezes” as the primary challenges to insourcing. There is no single practice or decision-making process that was identified as a “model” for all agencies, because, similar to the other types of traffic monitoring system activities, the needs, requirements, and culture of each agency is unique. Specific best practices that were identified come from the NJDOT and INDOT (although INDOT was interviewed under Category 3). During the interviews and follow-on conversations, the approach that New Jersey DOT (NJDOT) described was found to be noteworthy as a best practice. The NJDOT recognized the limitations faced during the staff reduction and hiring freezes several years ago and took a proactive approach of investing in the automation of certain tasks by industry-leading software applications. The key to NJDOT’s success was that the process was planned carefully to continue over multiple years. The funding plan for the implementation was also phased in a way similar to capital improvement projects and the data collection/equipment installation contracts were utilized as mechanisms to work on the phases of the concept design, software deployment, testing, customization, and verification. NJDOT’s contracts include a provision for “innovative concepts,” which allows for the testing new technologies or systems or investing in software applications. In summary, NJDOT recognized the challenges of understaffed conditions, assessed their options, and decided on the most feasible option of shifting some of the burden to automation so that data processing, validation, QA/QC checks, and as sensor reliability (in the next three years) are performed by a software system. This minimizes staff time required for those checks. Although staff still monitors process and data quality, the automation reduced overall staff responsibilities while still successfully getting the job done. There are additional timesaving benefits of automating quality checks, to include early error identification and real-time correction capabilities.

Although interviewed under Category 3 activities (details are in the following sections), INDOT shared their experience of switching their short-term portable counts from outsourcing to insourcing. The INDOT was outsourcing many of their TMS activities (mostly the short-term portable counts) for many years. The agency was giving specific directions to the contractors, but they realized that the quality of the data was diminishing and the contractor was not prioritizing based on INDOT’s needs and directives. After evaluating their options, INDOT undertook a major overhaul of their operations and decided to insource the short-term portable counts. The agency is extremely satisfied with the outcome of their decision, where the quality, cost-effectiveness and efficiency, as well as the prioritization are improved significantly. The decision required some startup activities, training of the personnel, and capital outlay, but the agency expressed that the change from outsourcing to insourcing was well worth it. Although one of the key elements in INDOT’s decision to insource was the lack of responsiveness of their contractor, it is worthwhile to understand that many agencies do not appear to undertake an evaluation of the costs, resource requirements, benefits, quality, and relevant elements associated with the resourcing practice that they are not using. The best practice of New Mexico DOT (discussed in the previous Chapter) to evaluate their resources and practices to develop justifiable decisions regarding insourcing or outsourcing is a good example of taking action without waiting for the quality or operational functions to deteriorate.

7.7 Perceived Advantages and Disadvantages of Insourcing or Outsourcing Portable and Permanent Counts

Nearly every agency that was interviewed indicated that decisions regarding their agency's resourcing practices are made at a level of management much higher than the agency department that is responsible for actually completing their portable and permanent counts. Many of the agencies interviewed that do in fact outsource their counts experienced challenges resulting from staffing caps, inadequate staffing allocations, funding shortages, and other insufficient resources that force them to resort to their current resourcing profile.

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.

Of the agencies that complete their portable and permanent counts in-house, the perceived primary benefits increased data control and improved data quality. Agencies also cite the familiarity of in-house staff with historical traffic patterns in their area as being extremely beneficial to TMS efforts and to early error detection.

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.

Agencies largely find it beneficial to have documented QA/QC procedures to reduce the impact of staff turnover, ensure data check consistency, and guarantee confidence in the final data product.

7.8 Summary of Findings - Category 2 Activities

The following is a list of the noteworthy findings based on the responses to the web-based questionnaire, agency interviews, and information gathering:

- Nearly every agency that was interviewed indicated that decisions regarding their agency's resourcing practices are made at a level of management much higher than the agency department that is responsible for actually completing the agency's portable and permanent counts. Many of the agencies interviewed who outsource their counts suffer from staffing caps, inadequate staffing allocations, funding shortages, and other insufficient resources that force them to resort to outsourcing.
- 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. Contribution of external and internal factors to the agencies' decision-making process was discussed in the sections under the Category 1 interview response evaluations. The same factors were also observed to be applicable to the decision-making process for Category 2 activities. *Table 6-2* in Chapter 6 summarizes the external and internal factors.
- 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.
- Many agencies have not undertaken a formal cost/benefit 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. However, several agencies expressed safety concerns about the risks of having their in-house staff on the side of busy roadways to perform counts, and in some cases, union rules actually prohibit staff from doing so.
- Those agencies who outsource their portable and permanent counts perceive that contractors are able to do counts quickly, reducing the time required for count season. These agencies also benefit from not having to employ the in-house staff to perform counts maintain necessary count equipment. The primary benefit of completing counts in-house is a perceived increase in data control and data quality. Agencies also cite the familiarity of in-house staff with historical traffic patterns in their area as being extremely beneficial to their TMS efforts and advantageous to early error detection. The perceived negatives of outsourcing data collection for some agencies were a lack of data control and relatively high costs compared to insourcing.
- A primary concern among agencies when considering insourcing counts is the safety of their staff who would be performing counts on the side of roadways. Union rules and the resulting job classifications can also be issues of concern for agencies that are considering a change to insourcing counts. Completing counts in-house also requires higher staffing levels and maintaining the necessary count equipment--which can be costly.
- Agencies largely find it beneficial to have documented QA/QC procedures to reduce the impact of staff turnover, ensure data check consistency, and guarantee confidence in the final data product.

7.9 Conclusions - Category 2 Activities

Limited documentation is available about the decision-making processes that support full or partial insourcing or outsourcing of state DOTs and other agencies' traffic monitoring program activities. This reveals a lack of defined processes behind resourcing decisions and a lack of periodic re-examination of such decisions. Current traffic monitoring contracting practices of state DOTs, MPOs, and local agencies involve varying levels of in/outsourcing for both installation of count equipment and execution of actual traffic counts, ranging from fully insourced or outsourced to partially insourced or outsourced. This research assesses the advantages and disadvantages that state DOTs, MPOs, and local agencies experience while in/outsourcing the sensor and/or equipment installations required for their traffic monitoring system. An online TMS resourcing profile assessment received 79 responses, with 41 coming from state DOTs, 32 from MPOs, and six originating from local transportation agencies. Interviews were conducted with 18 state DOTs, eight MPOs, and three local agencies, totaling 31 interviews to gather additional information about agency practices, resourcing rationale, decision-making processes, and other QA/QC activities for equipment and/or sensor installations, portable and permanent counts, and innovative contracting practices.

For the initial online assessment, there was a near-even split among MPOs and local agencies for fully or mostly insourcing and fully or mostly outsourcing portable and permanent counts. DOTs tended towards fully or mostly insourcing portable and permanent count activities. The majority of agencies that were interviewed for the portable and permanent count activities indicated that decisions regarding their resourcing practices are made by a level of management much higher than the agency department that is responsible for actually completing TMS counts. Of those agencies that outsource their count programs, a pattern of staffing caps, inadequate staffing allocations, funding shortages, and other insufficient resources emerged and were listed as the primary reasons for many agencies outsourcing their count program.

Those agencies that complete their portable and permanent counts in-house perceive the data quality to be better than it would via outsourcing due to their in-house staff's familiarity with the area's historical traffic patterns. Safety for staff performing roadway counts is a primary concern among agencies when considering insourcing. Union rules and the resulting job classifications can also be a concern for agencies considering a change to conduct count activities in-house. Completing counts in-house also requires higher staffing levels and count equipment maintenance, which can be costly. Two separately interviewed agencies benefit from utilizing college students during summer months to complete counts.

Those agencies who outsource their portable and permanent counts perceive contractors to be able to perform counts quickly and significantly reduce the count season. These agencies also benefit from not having to employ full-time or part-time in-house staff to perform the counts and maintain equipment.

Interviewed agencies at all levels largely find it beneficial to have documented QA/QC procedures to reduce the impact of staff turnover, ensure data check consistency, and guarantee confidence in the final data product. Agencies also believe it to be beneficial to have a documented decision making process for their resourcing profile when possible.

While traffic count data is mandated by Federal law and is critical to a robust national 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.

7.10 Recommendations - Category 2 Activities

A prevailing theme throughout agency interviews was the necessity for and benefit of documenting agency procedures and policies related to TMS practices. Nearly every agency stressed the importance of documenting decision-making processes and QA/QC procedures. Documentation for these practices and policies can greatly reduce the impact of staff turnover by providing knowledge continuity. It ensures that all agency staff members are following standardized procedures and increases confidence in portable and permanent count data.

Every agency interviewed performed some level of QA/QC on their count data. While these checks varied from manual to automatic and up/down stream to historical, every agency indicated that these checks are critical to the agencies' practices. These processes, whether documented or undocumented, help to ensure count equipment is installed and functioning correctly and contributes significantly to data quality and confidence.

For agencies that have the flexibility to make decisions regarding the resourcing profile of their portable and permanent counts, there could be substantial benefit in having a defined decision-making process for resourcing practices. A decision-making process could help to evaluate the resourcing options objectively and to choose the option that works best for each agency. Agencies could also benefit from a periodic re-evaluation schedule for resourcing practices. Many interviewed agencies have been utilizing their current practices for over 20 years without reassessment. A periodic re-evaluation schedule could help to ensure that an agency's resourcing practices stay current with evolving technology, agency staff capabilities, and costs associated with performing counts.

Ultimately, there is no one approach that works for every agency. Each agency performing portable and permanent 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 their most suitable resourcing profile. 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.

8.0 ASSESSMENT OF CATEGORY 3 ACTIVITIES – OTHER CONTRACTING METHODS

The objective of Category 3 activities is to document the success and challenges associated with the non-traditional, innovative, and cost-saving practices of the agencies that use internal or external resources a variety of TMS activities. These practices typically revolve around data and equipment sharing and exchange agreements with other agencies, using ITS data for TMS program, and data purchase agreements with the third party vendors.

8.1 Description of other Contracting Services

The activities included as a part of Category 3 in this effort are:

- Paying for quality data for a given time period (contractor obtained and quality-controlled by the agency)
- Buying data from other sources such as global positioning system (GPS) or probe-based data (e.g., INRIX™), or data collected by vendors using video detection (e.g., MioVision™)
- Equipment sharing techniques and agreements with other agencies
- Coordination of non-traditional sources to obtain counts such as data exchange/sharing agreements with other organizations or agencies, or interdepartmental agreements such as traffic data collected by ITS
- Integration of the TMS data into the agency's or regional Archived Data User Service (ADUS)
- Management and quality control of data feeds into regional transportation data portals/archives (e.g., RITIS©, iPeMS®, DriveNet™)
- Publication of annual TMS reports, traffic volume maps, trends, data tables, graphs, and geographic information system (GIS) shape files

8.2 Agency Resourcing Profiles

As discussed in the previous sections, a set of criteria was used in profiling the agencies and determining the alignment of their experience, practices, and resourcing profile with the objectives of this project.

Table 8-1 includes a list of agencies that were selected for interviewing, along with their profiles that were used in selecting those agencies.

Table 8-1. List of Agencies Selected for Category 3 Interviews and Their Resourcing Profiles

Agency	State	Category 3 Other Contracting Methods									
		Paying for quality data for a given time period	Paying for quality data for a given time period	Buying data from other sources	Equipment sharing techniques and agreements with other agencies	Coordination of non-traditional sources to obtain counts	Integration of the TMS data into the agency's or regional Archived Data User Service	Management and quality control of data feeds into regional transportation data portals/archives	Publication of annual TMS reports, traffic volume maps, trends, data tables, graphs, and GIS shape files	Other	
Alaska DOTPF	AK	MO	MO	FI	FI	FI	FI	FI	FI	FI	FI
Indiana DOT	IN	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
Nebraska DOR	NE	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
Idaho Transportation Department	ID	MO	MO	MO	MO	MO	MO	MO	MO	MO	MO
Delaware Valley Regional Planning Commission	PA					FI	FI	FI	FI	FI	FI
Southeast Michigan Council of Governments	MI	FO	FO	FO		FO	MI	MI	FI		
Southwestern Pennsylvania Commission	PA	MO	MO	FO	MI	MI		FO	MI		
City of Charlotte DOT	NC			FO		FO	MI	FO	MO		

KEY

FO Fully Outsourced
 MO Mostly Outsourced
 MI Mostly Insourced
 FI Fully Insourced
 N/A

8.3 Agency Interviews and Evaluation of Responses

The following sections list the questions as they were asked to the interviewees, and summarize the categorized responses and discussions. The responses were summarized to only a select number of key interview questions, where the responses provided a variety of the issues and challenges faced by the agencies, as well as experiences and solutions to those challenges and barriers identified by the state DOT, MPO, and local agency personnel that are involved in the administrative and technical aspects of traffic data collection.

8.3.1 Interview Questions

The interviews for Category 3 included eleven questions and one discussion question grouped under the following four categories:

- Organizational Practices
- Decision-Making Processes
- Quality Assurance/Quality Control (QA/QC)
- Proposed Processes (discussion question)

Organizational Practices

1. You indicated that your agency in/outsources data collection activities.

- a. How many years have you been in/outsourcing the data collection activities?

Data Purchase Agreements (paying for specific quality data or buying bulk data from vendors)

- b. Why did you decide to procure data purchase from vendors/third parties?
- c. What are the benefits of purchasing data from vendors/third parties?
- d. What are the challenges of purchasing data from vendors/third parties? How do you overcome those challenges?
- e. How do you control the data quality?

Data Exchange Agreements

- f. Who is in your pool for data exchange agreements? Do you exchange data with agencies located outside of your state?

- g. Why did you decide to establish data exchange agreements?
- h. What are the benefits of data exchange agreements?
- i. What are the challenges of data exchange agreements? How do you overcome those challenges?
- j. How do you control the data quality?

Equipment and Resource Sharing Agreements

- k. Who is in your pool for equipment and resource sharing agreements? Do you share resources with agencies located outside of your state?
- l. Why did you decide to establish equipment and resource sharing agreements?
- m. What are the benefits of equipment and resource sharing agreements?
- n. What are the challenges of equipment and resource sharing agreements? How do you overcome those challenges?
- o. How do you control the data quality?

Interdepartmental Agreements such as Traffic Data collected by ITS Devices

- p. Do you have such practices/agreements? Reason?
- q. What are the benefits of obtaining traffic data collected by ITS devices?
- r. What are the challenges of obtaining traffic data collected by ITS devices? How do you overcome those challenges?
- s. Is the ITS-collected data used as primary or supplemental data?
- t. How do you control the data quality?

Data Feeds into Regional Transportation Data Portals/Archives (e.g., RITIS®, iPeMS®, DriveNet™)

- u. Do you feed data into regional archives/portals? Reason?
- v. What are the benefits of insourcing/outsourcing of data feeding?
- w. What are the challenges of insourcing/outsourcing of data feeding? How do you overcome those challenges?

Publication of Annual TMS Reports, Traffic Volume Maps, and GIS shape files

- x. How do you handle reporting, graphics, maps associated with traffic data (insourced or outsourced)? Any on-site consultants assisting you with such tasks?
- y. Any benefits or challenges associated with in- or outsourcing the data reporting?

General Assessment of Traffic Data Collection

- z. Do you have documented procedures for data processing (i.e., formatting, imputing, and extrapolating)?
 - aa. Did you ever compare the data quality for the periods when the process was in- or outsourced (i.e., before-after comparison)? If yes, what were your findings/observations?
2. Does your agency possess the necessary technical capabilities to manage TMS activities in-house?
- a. If you have experience with both in- and outsourcing, do you believe outsourcing TMS activities improves quality, lowers quality, or is about the same when compared to insourcing?
 - b. Are there any barriers that prevent your TMS activities from being completed in-house?
 - c. Please define the barriers that you already identified. Did you ever take actions to overcome the identified barriers? What were those actions?
3. Does your agency rely on on-site consultants for data collection or processing?
- a. Can you describe your agency's experience with the process?
 - b. Do you see having the on-site consultants for data collection and processing beneficial to your agency?

Decision-Making Processes

4. Does your agency have a defined process for decisions regarding [outsourcing/insourcing] of the TMS activities. (Follow-up to I1 and C1)
 - a. Can you briefly describe this process or the reason why you do not have a process in place?
 - b. Is it formalized? Is the process documented?
 - c. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties.)
 - d. Does this process work well for your agency?
 - e. How could it be improved?
 - f. How long has your agency been using this procedure?
 - g. Has it undergone any recent changes? If so, why?
 - h. How does your agency evaluate the advantages/disadvantages of outsourcing versus insourcing?
 - i. In a perfect world, how would this process be handled?
 - j. Who makes the final decision in this process?
 - k. How often, or what, would cause this decision to be reevaluated?
 - l. What would you change in the current process to make improvements?

Quality Assurance/Quality Control (QA/QC)

5. Does your agency have a warranty policy for data services and quality of data? (Follow-up to E4)
 - a. If yes, how many years does the warranty typically cover?
 - b. Do you see it beneficial to have a warranty policy and what are the benefits of having a warranty policy in place?
6. Does your agency have documented requirements/processes for QA/QC for your TMS activities?
 - a. Can you briefly describe those requirements/processes?
 - b. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties)
 - c. Do you see it beneficial to have a documented QA/QC policy? If yes, what are the benefits?
 - d. What would you change in the current QA/QC process to improve it or make it more effective/efficient?

Proposed Processes

The objective of the “Proposed Processes” section was to gather information for use in the development of processes/matrices as part of the research recommendations, and the agencies that provided substantial input for this section could be contacted once more after the recommendations are drafted. This section of the interview involved open discussions regarding specific agency experiences associated with the processes based on the resourcing type of the agency, lessons learned from past programs/practices, and focus on gathering feedback/input for potential processes that the research team had in mind. Examples include suggestions for process improvement measures, a decision-making process that could work for your agency (proposed but has not been implemented due a specific reason), or a process that you tried and refined after many iterations.

8.3.2 Summary of Interview Discussions

The following sections summarize the responses and discussion items. The format of the interview process was different from the previous two categories, because the contracting methods involving data and equipment sharing agreements and data purchase contracts are agency-specific. The interviewers focused on the specific activities of the agencies and gathered information regarding the agencies experiences, rationale behind selection of certain contracting methods, and any challenges they might have faced throughout their experiences. Therefore, the intention of the following interview summaries is not to present the distinction between insourcing and outsourcing certain activities, but to present the experiences of the different agencies about non-traditional contracting methods to obtain traffic data, along with some of the challenges and success stories that they experienced. It is also important to understand that, although most of the selected agencies responded that they either fully or partially insource these types of activities, the resourcing in this case refers primarily to management of such data/equipment sharing agreements or data purchase agreements. **Table 8-2** in the following pages shows a summary of the specific activities and contracting methods that were the foci of the interviews with the agencies.

Table 8-2. Noteworthy Non-traditional Contracting Methods under Category 3 Activities

Question 1b through 1aa (Summary): What are some of the non-traditional activities, agreements, or contracting methods used by your agency?		
Agency	Resourcing	Activity or Contracting Method
CDOT	Fully Outsourced	<ul style="list-style-type: none"> • Data collection is performed in-house, but has contracts to outsource when needed (periods of surge in data needs) • Subscribes to INRIX™ data through RITIS as a supplement to validate CDOT-collected data • Working with MS2™ to develop database and make it available publically (instead of fulfilling individual data requests from users and other agencies)
ITD	Mostly Outsourced	<ul style="list-style-type: none"> • Uses in-house camera equipment to collect traffic data and has agreements with MioVision™ to process the collected data • Cameras are used to replace manual intersection movement counts • Cameras are used to replace the manual ATR¹² validation counts • Shared workforce with other departments • Report cards for annual performance to evaluate advantages and disadvantages of the methods for the TMS activities • College interns develop software to document or track processes
Alaska DOT&PF	Fully Insourced	<ul style="list-style-type: none"> • College engineering interns are performing traffic counts • Purchased MioVision™ video equipment to collect traffic data and has agreements with MioVision™ to process the collected data • Equipment loan agreements with other boroughs (Memorandum of Agreement – MOA) • Contractors use Alaska DOT&PF equipment

Table 8-2 (continued). Noteworthy Non-traditional Contracting Methods under Category 3 Activities

Question 1b through 1aa (Summary): What are some of the non-traditional activities, agreements, or contracting methods used by your agency?		
Agency	Resourcing	Activity or Contracting Method
INDOT	Fully Insourced	<ul style="list-style-type: none"> • Recent switch of equipment/CCS maintenance decisions from outsourcing to insourcing • Plans to start progressing outward from current ITS deployment • Data sharing across the state agencies (without formal agreements)
NDOR	Fully Insourced	<ul style="list-style-type: none"> • Informal data sharing with the City of Lincoln and the City of Omaha • Purchases INRIX™ speed data • Informal equipment loan to MPOs or municipalities • Data processing and AADT calculations for municipalities
DVRPC	Fully Insourced	<ul style="list-style-type: none"> • Uses INRIX™ data through I-95 Corridor Coalition agreement • Developed a regional traffic count database to warehouse data from DVRPC, PennDOT, HERE™ (formerly Traffic.com™), and consultants (on a volunteer basis) • Requires that all data from outside sources pass the QA/QC process of DVRPC before being incorporated into the database • Doctoral students from University of Pennsylvania, as well as agency staff code software for DVRPC • Has custom software to automatically check data quality • College students (undergraduate and graduate) transcribe intersection turning movement counts from video recordings
SEMCOG	Combination	<ul style="list-style-type: none"> • Uses commercial traffic count database (MS2™)to warehouse data from MDOT and local/county governments • Requires that all data from outside sources pass the QA/QC process of SEMCOG before being used for projects or incorporated into the repository (SEMCOG Regional Traffic Counts Database) • SEMCOG improves the data collected by the seven county road commissions • Actively monitors the developments in data collection technologies and researches new methods for more efficient/effective data collection program • Using smart sensors to obtain traffic data • Working on getting traffic count data using cell phones as probes • Uses cutting-edge traffic count software and ensures new technologies/ and data collected by those technologies are compatible with existing software
SPC	Combination	<ul style="list-style-type: none"> • Uses INRIX™ data through I-95 Corridor Coalition agreement • Uses Bluetooth detection devices (owned by the agency) in temporary installations to gather travel time, speed, and origin/destination data on arterial corridorsShares data with counties, cities, and planning partners in the region • Uploads traffic count data to a “GIS-like” portal on the agency’s website for public access

Most agencies interviewed about their innovative contracting methods demonstrated some degree of reliance and/or utilization of outside companies for the collection, processing, storing, and dissemination of traffic count data. Several of the interviewed agencies obtain data from INRIX™ and are using MioVision™, and some agencies utilize companies such as MS2™ or IRD™¹⁴ for their data archiving and storage. Two agencies also noted the success they have had with utilizing college interns to perform short-term counts during summer months.

Much of the use of innovative methods for obtaining traffic counts serves to supplement existing data or to assist the agency in collecting data that it is not able to do due to funding or staffing shortages. While the current use of innovative methods is largely supplemental, other agencies are starting to evaluate the advantages of switching to newer methods like cameras or Bluetooth® sensors to complete the majority of their counts.

Most agencies share either data or equipment with other partner agencies but few had formal agreements; the most formal agreement that encountered was in the form of a memorandum of agreement/understanding.

¹⁴ International Road Dynamics: <http://www.irdinc.com/pages/its-solutions/traffic-monitoring-data-collection.html>

Organizational Practices and General Assessment of Traffic Data Collection

Question 1a: Can you briefly describe your agency’s process for insourcing/outsourcing of the TMS activities? Question 2: Does your agency possess the necessary technical capabilities to manage TMS activities in-house? Question 3: Does your agency rely on on-site consultants for data collection or processing?		
Agency	Resourcing	Response
CDOT	Fully Outsourced	CDOT contracts out the volume and classification counts because of the amount of work that involves collecting that data using in-house resources. The City currently uses INRIX™ data through RITIS. As a member of the I-95 Corridor Coalition, the City does not purchase this data, but that may change in the future. RITIS processes the INRIX™ data, which allows the City to pull bottleneck information.
ITD	Mostly Outsourced	The agency insources data collection but also gets data from outside sources. Has data sharing agreements with other local transportation agencies to collect short-term counts. With outside agencies supplying data, the small staff collecting data in the field can focus on areas not already covered by those outside agencies.
Alaska DOT&PF	Fully Insourced	The operations are divided into three regions. Practices for the regions are similar but not identical. In central region the agency has a combination of in-house operations and contractors. The agency has been contracting for approximately ten years. Approximately 17 years ago, student interns were performing the counts. Currently, the agency hires four interns (typically engineering students) and contractors for certain types of work.
INDOT	Fully Insourced	All WIMs and ATRs ¹² are maintained by agency in-house through the ITS department. Data is then handed off to the planning department who passes the data to MS2™ team to process data. This has been the process for the last five years. ITS technicians perform site inspections and use the agency’s contract with IRD™ to do repairs. Recently upgraded communications to radio. Now focusing on retrieving data from sites and uploads to site where planning gets the data. IRD™ used to decide what needed fixed and when and “were handed a check at the beginning of the year.” However, this practice has changed, because it was too much for IRD™ to maintain efficiently and the agency experienced massive communications failures. The current communication lines run with 99% reliability.
NDOR	Fully Insourced	NDOR has been utilizing their current data collection practices since the early 80s. The agency now has a contract with INRIX™ to collect speed information. This speed data is not used for TMS purposes. The agency has no formal data exchange agreements but does currently share data with the City of Lincoln and the City of Omaha. As the state only has four MPOs, the value of formal data exchange agreements is uncertain. The data received by the agency through data exchange agreements do not undergo any additional quality control checks other than those performed by the collecting agency do anything to control that data. The agency also gets data from City of Lincoln and City of Omaha with limited mechanisms to check data quality. NDOR performs counts on highways system.

Question 1a (continued): Can you briefly describe your agency’s process for insourcing/outsourcing of the TMS activities?
Question 2: Does your agency possess the necessary technical capabilities to manage TMS activities in-house?
Question 3: Does your agency rely on on-site consultants for data collection or processing?

Agency	Resourcing	Response
DVRPC	Fully Insourced	The agency does not contract data collection from third-party vendors for traffic counts. The Office of Transportation Safety and Traffic Management uses INRIX™ data and the agency has access to data through the I-95 Coalition. The Office of Traffic Monitoring has a staff of three full-time office staff and seven full-time field personnel. The DVRPC is responsible for the PennDOT counts in the PA section of “Philly region.” Originally, the intention was to create a regional resource for traffic data to eliminate duplication of efforts from different data collection entities. The DVRPC accepts count data submitted by other jurisdictions/agencies in their database.
SEMCOG	Combination	Every five years, all screenline and external station counts are outsourced for over 20 years, although in-house capabilities existed 20 years ago. The agency is on its fourth round of contracts this year. SEMCOG has a very expansive QA/QC process for contractors and in the COG. Data needs of SEMCOG are different from a typical DOT, because supplemental data are needed to run and calibrate the transportation demand model. Some data are available from Michigan DOT (MDOT), but because of SEMCOG’s model input needs, data along specific roadway section/segments and for specific years are necessary. When the data are not available from MDOT, SEMCOG uses contractors to collect the needed/missing data. However, when the roadway sections involve freeways, the contractors might not have the capability to collect the data and SEMCOG requests the data be collected by MDOT. Bid on contracts for traffic counts. Contractors are required to put all counts into the same software.
SPC	Combination	Most agency counts are done in-house. Three full-time staff members are utilized to do counts in the field. The agency is not currently buying data for traffic counts but does have access to RITIS probe data through PennDOT. This RITIS data is used in the agency’s congestion management process and used to produce charts and performance measures for congested corridors.

Decision-Making Processes

Question 4: Does your agency have a defined process for decisions regarding insourcing/outsourcing of the TMS activities? Can you briefly describe the decision-making process, rationale, and your experiences?		
Agency	Resourcing	Response
CDOT	Fully Outsourced	CDOT contracts out the volume and classification counts because of the amount of work that involves collecting that data using in-house resources. The City currently uses INRIX data through RITIS. As a member of the I-95 Corridor Coalition, the City does not purchase this data, but that may change in the future. RITIS processes the INRIX data, which allows the City to pull bottleneck information.
ITD	Mostly Outsourced	Data collection agreements with other agencies are embedded in the culture of the agency. There is no formal process for decision-making, which can make the process challenging. As the organization changes through retirements and restructuring, the knowledge base for making these decisions may no longer exist, or the focus of management may change, affecting implementation and innovation timelines.
Alaska DOT&PF	Fully Insourced	Decision-making process is more of a regional one. Localized decisions for betterment of the TMS program is made by the department. For decisions that require collaboration, the alternative is the HQ decision model. Keeping both insourcing and outsourcing options is good, because conditions change (e.g., if there were no more summer internship program, data collection activities would require to be outsourced).
INDOT	Fully Insourced	Decision-making process depends on the projects (scope and staff involvement). Decisions to insource versus outsource also depends on the project. If the department decides that something needs to be insourced or outsourced, they would prepare a financial analysis and “run it up the chain.” Management performs the analyses and comparisons on a spreadsheet and then the findings are summarized in a document. This is done on “per occasion”; there is no standard program or spreadsheet, because it depends on data needed and cost. Procurement department will put a purchase agreement together for what needs to be done. Once those bids come in, they have to be approved by auditor, finance, central office, and other decision-makers, which can be a lengthy process.
NDOR	Fully Insourced	Outsourcing decisions would be made at the data collection level. If better products available, then the agency might be open to outsourcing. The agency believes that new technologies will soon replace many of the data collection techniques being used today. At that point it may make more sense to outsource the activities so the agency does not have to maintain and keep up with this rapidly evolving technology. Currently, there are no incentives or driving forces for NDOR to outsource the data collection activities. “Nobody can offer a better quality product for less money right now.”

Question 4 (continued): Does your agency have a defined process for decisions regarding insourcing/outsourcing of the TMS activities? Can you briefly describe the decision-making process, rationale, and your experiences?

Agency	Resourcing	Response
DVRPC	Fully Insourced	The decision to outsource would be up to the administration of the agency to reevaluate. Would have to look at the cost structure. If the agency found that the cost of insurance, for instance, for insourcing would significantly increase, the comptrollers would see the red flag and contact the managers, then the agency would have to reevaluate. The agency's liability insurance also has to cover the work performed by the contractors and any injury/fatality while contractors are performing fieldwork would be a cost for the agency. Therefore, the agency leverages that risk by equipping their vehicles with "every piece of safety equipment imaginable," and never experienced an incident thus far.
SEMCOG	Combination	SEMCOG used to insource data collection in the past, but not anymore. Made a decision 20 years ago not to perform counts in-house because of many liability issues associated with fieldwork. Relies on contractors, local and county governments, and MDOT to do counts for them. In the past information was gathered in many different formats, spent a lot of time putting data into database. Identified major supplier of traffic count data and pay for software for all suppliers to input data. All data is now entered into same program.
SPC	Combination	No formal decision-making process, but the agency will outsource if there are too many counts that need to be done at once or for specific projects. Agency staff cannot be on interstates so that provision also necessitates hiring a contractor.

Of the agencies that either fully or partially outsource their TMS activities, the decision to do so is largely made outside of the department that would be performing the counts. One agency cited the large strain on resources that performing counts in-house would require while another indicated that the data obtained through agreements with other agencies is deeply imbedded in the culture of the organization. There are many factors influencing the agencies' decisions regarding insourcing or outsourcing their data collection and other TMS activities. Factors influencing the decisions regarding data purchase or agreements with other agencies/departments are not different from in/outsourcing decisions. These factors are dynamic and require the agencies to have the flexibility in their decision-making processes. Therefore, many agencies prefer one resourcing method to the other due to the flexibility it provides during times of surge in data collection requirements, seasonal suspensions, or special periods where high volume of data is needed. For example, SEMCOG had previously conducted all counts in-house but stopped doing so approximately 20 years ago due to liability issues. The SPC outsources its counts only when the required volume of counts exceeds that of the agency's capabilities.

Decisions regarding the resourcing of TMS activities for agencies that either fully or partially insource are also largely made by upper management. Of those agencies interviewed, however, there was an exhibition of a willingness among upper management to consider alternatives to their current practices if it were financially feasible. While no agency was able to demonstrate a formal decision-making process, per se, most of the agencies had a known process that would be followed if a change in course were to occur.

Question 5: What are some of the advantages/disadvantages of insourcing or outsourcing innovative contracting methods (or in/outsourcing in general)?		
Agency	Resourcing	Response
CDOT	Fully Outsourced	CDOT views it beneficial to have in-house staff enter collected data into MS2™ software. While the software was not created in-house, having in-house staff enter the data in allows for quicker response time in fulfilling requests while making others aware of what is and what is not available. The agency also sees it beneficial to contract out data counts for special studies when a large volume of data needs to be collected at one time.
ITD	Mostly Outsourced	The agency finds it beneficial to have agreements with other agencies to outsource data counts. This allows the small number of field crew a chance to focus, and helps mitigate the count needs during crew shortage or turnaround. These agreements do require additional time and effort to put data on department's linear reference system and coordination with other units within the agency, however. The agency also finds it beneficial to utilize Miovision as it enables the agency to get traffic counts in places where short-term counts are not feasible and classification counts in places where counts with tubes are impossible.
Alaska DOT&PF	Fully Insourced	The agency requires contractors to use the agency's counters when performing traffic counts. The agency believes that this gives them greater control over the data and prevents contractors from editing any of the data files. Doing counts in-house would be difficult due to it requiring hiring additional interns. Having interns and contractors completing the counts prevents the agency from "putting all their eggs in one basket."
INDOT	Fully Insourced	INDOT thinks it would be more beneficial to invest in in-house ITS deployments as it allows them to control how much data they want from any given site. This would also give them more access to the data as well. A challenge to maintaining data publishing websites in-house is that it requires finding, hiring, and keeping the right people but that doing so allows for making changes quickly and with no additional cost. They realize, however, that outsourcing their data publishing websites could produce a better quality product as those contractors would do this type work for a living every day. The agency outsources equipment installations due to liability issues. Thought they would prefer to do data processing in-house, these activities are currently outsourced due to the difficulty of hiring staff with the right knowledge. The issue of inadequate funding allocated for new staffing hires also makes in-house data processing difficult.
NDOR	Fully Insourced	The agency sees it beneficial to publish their own traffic volume maps as it gives them greater control over what is published. While the agency currently does their counts in-house, they realize that in the future it may be more beneficial to outsource counts due to the rapid advancement of technology. This would prevent the agency from having to keep up the technology changes.

Question 5 (continued): What are some of the advantages/disadvantages of insourcing or outsourcing innovative contracting methods (or in/outsourcing in general)?		
Agency	Resourcing	Response
DVRPC	Fully Insourced	DVRPC has previously looked at outsourcing counts but were very reluctant to let go of the in-house staff in order to hire consultants. Liability is also an issue as the agency is concerned that consultants being injured or killed while in the field during data collection or installation activities, because the contracting firm did not hire a trained professional to do them. The agency finds it beneficial to publish their data online in-house due to the quick turnaround.
SEMCOG	Combination	A primary reason for not doing counts in-house is the high liability. The agency finds it beneficial to outsource counts as all data collectors use the same software are getting many more counts. Mandating that the data that is published to the regional archive can only be edited by SEMCOG or the county that collected it helps with agency buy-in. The agency finds it beneficial to process and QA/QC all data in-house as their people know the roads. Available funding is also a big factor when it comes to deciding between insourcing and outsourcing TMS activities.
SPC	Combination	The agency finds it beneficial to outsource counts only when there are too many counts needed in a short amount of time. The agency also must outsource when counts are required on interstates as agency staff are not permitted to perform counts on these roadways. The agency also views RITIS data as being very beneficial as it provides the agency with more data and more free time to complete other data collection activities.

Quality Assurance/Quality Control (QA/QC)

Question 6: Does your agency have documented requirements/processes for QA/QC for your TMS activities?		
Agency	Resourcing	Response
CDOT	Fully Outsourced	RITIS™ processes the INRIX™ data, which allows CDOT to pull bottleneck information. This information is used to determine travel time and to verify field data and assumptions made based on a one-time collection period. Agency staff use working knowledge of the area to challenge this data, and has found that it became better over time. CDOT has seen that it is more consistent with what is known anecdotally. The agency uses count data to help develop estimates for level of service at intersections and the INRIX™ data is used as a supplement to the full day-to-day averages. RITIS™ data has not changed data collection practices and only acts as a supplement. CDOT had access to RITIS™ for over a year and has been using it for less than a year, which has not been enough time to come across major errors.
ITD	Mostly Outsourced	The ITD does not have a specific data control methodology in place. The agency finds that external or purchased count data are very similar to what it should be based on historical trends. If there is a discrepancy, the ITD data takes priority. Historically, the data consistency has been very good. There are not any formalized rules for choosing an AADT. Rather, ITD uses a “smoothing” method, taking into account any number of variables, ranging from continuous counts on a route to time of year short-term counts were taken to holidays. AADTs across routes are examined from a historical perspective to determine if there may be potential issues with any counts taken through the year, and to determine the AADT. Distance from the border comes into play, because ITD works with neighboring states to verify reasonableness of routes shared across states lines.
Alaska DOT&PF	Fully Insourced	The agency places emphasize on the data quality. Recently changed the database, where the old database was almost like a database administration server (DAS) database that did not have any built in quality checks. Everything would be done visually. We have a new database from TransMetric™ that has built in data checks. Still trying to verify that we are getting quality data from them. Short-term count manager also does spot quality checks. Traffic analysts will review the database in more detail. Combination of manual and new database. In-house collected data and contractor data all goes through the same checks.
INDOT	Fully Insourced	For data processing, there is a documented QA/QC process with MS2™. They have a schedule for what they look for in the data, will try to get documentation. Have documentation in place for site performance. Without documentation they can say that it works but not know how well it works. Each person has a different standard for how well something is working. The system compares data on a stretch of road from one year to the next but they have no way of finding out if there was a detour or repaving.

Question 6 (continued): Does your agency have documented requirements/processes for QA/QC for your TMS activities?		
Agency	Resourcing	Response
NDOR	Fully Insourced	When we collect data it goes through an initial screening before it ever goes to the data analysis group to ensure regularity in the data. This screening checks for anomalies. The data analysis group goes through a similar process. Automated process checks the data against historical data. If it does not match, an analyst will review the data manually.
DVRPC	Fully Insourced	The agency has a DVRPC Policy and Procedures Manual where the QA/QC process is documented.
SEMCOG	Combination	One of the measures used in consistency of data is to require all contractors to use the same software. SEMCOG finds this beneficial, because it streamlines the monitoring of the quality of traffic data from different sources and it allows SEMCOG to control the quality. Within the aforementioned software, there are several quality checks where the data has to pass through nine or ten QA/QC measures. After the data is submitted to SEMCOG by the contractors, it undergoes through another ten to fifteen QA/QC measures. The entire process allows SEMCOG to focus on quality rather than quantity.
SPC	Combination	The agency performs standardized data checks to ensure that the data is compatible and acceptable by the PennDOT system. When it is uploaded to PennDOT system, it will kick out any data that are irregular. The checks that the agency does in-house are manual and are based on the agency's institutional knowledge with the area and past data.

Nearly every agency interviewed indicated that they have some type of QA/QC process for their collected data. There was no real trend on whether this data underwent manual or automatic checks but it is largely compared to historical data from the same site. When evaluating the data obtained from a third party, the interviewed agencies varied on whether additional checks were performed. Some agencies accepted data as-is from third parties while others put it through their own in-house checks as if they had obtained it themselves. The QA/QC procedures are typically documented on an “ad hoc” basis and most of the time the QA/QC process exists as part of the institutional knowledge within each agency.

Proposed Processes

Question about Agencies' Proposed Processes		
Agency	Resourcing	Response
CDOT	Fully Outsourced	CDOT does have access to North Carolina DOT's data and the City's data are available for anyone by request. Charlotte has contracts with MS2™ and it is now uploading data to their database. Although it is not yet available, the data sharing will be in place. CDOT's data are used by the local MPO, but the City very rarely uses the MPO data. Although the local MPO is housed within CDOT, there is no consistent sharing technique. MS2™ data will eventually be made available to public, but for now will only be used to assist in formalized sharing with other agencies. All of the data CDOT collects is put into MS2™ by staff in-house. The agency is currently working to make their data available online to any agency that wants to have access to it. This will save CDOT time that was previously spent fulfilling data requests, and make others more aware of what is (or is not available).
ITD	Mostly Outsourced	With restructuring and staff turnover at ITD, some initiatives have stumbled while others have succeeded. In some cases, institutional knowledge has been lost because of the time it took to refill a position. This has also resulted in the loss of undocumented processes and time spent re-creating or re-designing processes. ITD definitely needs formalized procedures and people need to understand them, particularly with several office staff in traffic retiring in the near future. "The person that approves a decision one week may not be the same person that you need approval for the next week." In the areas that these formalized processes have been established, it has been very successful.
Alaska DOT&PF	Fully Insourced	All of Alaska DOT's recommendations would be for a similar sized population to Alaska. Alaska is in transition and the agency believes that they will be getting into more contracts in the future. In the past, it has been beneficial to have everything done in-house. Although still under a million people, the State's population is growing. Many people are interested in outsourcing or innovative contracting for data, and they would see it as the future. "It is the future, but at what point do we want to go in that direction?"
INDOT	Fully Insourced	The decisions are being made by management that is outside of the TMS program or department. The interviewee indicated that the person(s) who know the departmental needs the best are the people in the department. Therefore, in order to make effective decisions, more decision-making strength should be given to the department staff and take advantage of localized knowledge about the operations and needs. Standard process was to hand the contractor a check to take care of count sites. This contractor would handle the counts at their discretion. There was minimal communication between the contractor and the agency regarding the data quality, process, or prioritization. Some of the sites were closed for three or four years. The agency became very dependent on the contractor. "It was like letting the fox run the henhouse." The agency re-evaluated the resourcing practice and decided to insource and "everything is much better including the quality."

Question about Agencies' Proposed Processes (continued)		
Agency	Resourcing	Response
NDOR	Fully Insourced	NDOR believes that “it all revolves around the fact that the agency has control over the process and control over the quality.” Approximately five years ago the agency attempted to outsource some installations, since then the agency has been replacing and repairing problems that contractors injected into the site. Quality of work was not what it needed to be. NDOR has been correcting problems ever since. The agency spent a lot of time and effort to make sure the agency is using best practices and best equipment. Have people trained to a level so that they know how and what and why they are doing it. Potential savings versus integrity of process and quality that NDOR would get from insourcing are the reasons why NDOR has not seriously considered outsourcing practices.
DVRPC	Fully Insourced	DVRPC believes that having the support of the agency’s administration is important in decision-making process. Having a strong support means having funding and backing. The agency discussed setting up non-motorized count programs with other agencies. Their approach was to transfer the knowledge gained from the motorized data collection activities to non-motorized. “No reason to start from scratch on the non-motorized side when we have learned from our mistakes on the motorized side that we can use as a foundation.”
SEMCOG	Combination	SEMCOG does not specify which technologies are utilized in the contracts due to SEMCOG’s trust in contractors’ expertise. However, SEMCOG is open to new technologies suggested and used by contractors. If a new technology comes online then SEMCOG talks to vendors to verify that that technology is compatible to the software that is already deployed in SEMCOG’s system. SEMCOG believes that the technology is changing constantly and the agency is considering implementing traffic count data from cell phone probes. The agency is already getting counts from smart signals.
SPC	Combination	The agency has had negative experiences in the past with contracting to counties to do counts. They try to insource as much as possible but sometimes are forced to outsource, especially when the counts have to be done on interstates or interstate on/off ramps. The agency also utilizes college interns in the summer to complete required manual counts and has benefited from that program. The agency sends a full-time staff member to check on the students and has not had any real issues with data quality. This program also saves the agency money compared to full-time staff. The agency would be interested in learning more about how other agencies house their data and how they streamline getting the data from the counters, manipulate it, and upload it to their database. A clearinghouse would be very useful for count technology and software.

8.4 Rationale for Agencies' Resourcing Practices for Other Contracting Methods

As presented in the previous sections, most interviewed agencies were utilizing their current resourcing practices because the agency has been doing it for many years, and often times many decades. 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. 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. 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. Citing inadequate funding or employee allocation, obtaining data from other sources helped agencies to obtain necessary data without overextending agency resources. One agency, NDOR, stated that their decision regarding insourcing is based on their preference of integrity of process and quality of data rather than potential savings that could be achieved by outsourcing.

8.5 Experiences, Challenges, and Success Stories of Agencies for Other Contracting Methods

Few interviewed agencies experienced drawbacks with using innovative contracting methods. While some agencies who obtain data from other sources, such as RITIS™, only do so because of their involvement in external organizations such as the I-95 Coalition, having the additional data nearly always proved beneficial to the agencies. It was not expressed explicitly during the interviews, but one of the reasons that the agencies have access to externally collected data could be the organizational agreements that they have, such as the I-95 Coalition. It was, however, not determined if the external data would have been used if procurement of such data were through agency funding rather than under the organizational coalitions.

Some of the interviewed agencies expressed concern over the quality of third party data. Agencies that were skeptical of utilizing this external data expressed their concerns based on the uncertainty regarding that data vendor's QA/QC procedures. While concerns over using innovative contracting methods exist, most of the interviewed agencies expressed a receptiveness to these new technologies as long as they were accompanied by cost savings and a guarantee of quality. It was also noted that none of the agencies expressed concerns about continuously monitoring the quality of the data that are purchased or obtained from other agencies, but one agency stated that they perform data validation by using in-house resources or hiring a third party (i.e., Texas A&M Transportation Institute) prior to purchasing data from sources such as INRIX™. One agency stated that they perform QA/QC on the data before they upload it to their database for agency-wide or public use.

Several of the agencies also benefited from the utilization of college students during summer months for the completion of short-term counts. Contracting college students for the completion of short-term seasonal counts prevented agencies from having to hire full-time staff members to complete counts that could only be conducted in the relatively short count season. Employing college students is relatively cost-effective when compared with hiring full- or permanent part-time staff members. Seasonal hiring of

college students allows agencies to pay staff members during the months they can actually complete counts and not have to sustain full-time staff during off months.

When asked about obtaining data from ITS devices that are deployed by other departments within their agency, the interviewees stated that they do not collect data using the already-deployed devices such as CCTV, traffic monitoring/detection cameras, loop detectors, remote sensors, etc. However, interviewed agencies expressed curiosity about the feasibility of such agreements/initiatives and they asked for examples from other agencies.

8.6 Summary of Best Practices reflecting Cost and Time Efficiency, Effectiveness, and Reliability for Other Contracting Methods

One of the noteworthy practice that was uncovered was validation of the data being obtained, the new technology being utilized, or the quality of the operations or product from the outside vendors. Few agencies expressed concern about the quality of a new technology or data collected using new technologies that they are not familiar. The majority of the respondents indicated that they typically perform their internal QA/QC procedures on the data collected using newer technologies or the data that is purchased from the third-party vendors.

Similar to the other categories, the importance of documentation for process improvement and continuity was emphasized by many agencies during the Category 3 interviews. The Idaho Transportation Department (ITD) addressed the challenges associated with documentation by initiating documentation for the new processes. For example, the engineering interns develop new software for ITD's traffic monitoring department. When it was all documented, it made it much easier for a new person to step in and pick up where the previous person left off. ITD strongly believes that documentation helps tremendously in continuity and there is tremendous loss of knowledge when someone leaves the department or the agency. Especially if that person has been there for a long time, and the processes or procedures were not documented properly. Although it could be time consuming, starting a documentation process for new initiatives/procedures, and following the documentation practice to capture existing procedures would be ideal in order to have repeatable processes regardless of staff changes, thus achieve overall continuity.

The importance of knowledge and technology transfer (KTT) was discussed during the interviews with the DVRPC. The agency presented a good example of how they transferred their knowledge gained during the development of the motorized traffic data collection program and database to the creation of the non-motorized traffic data collection program. Many agencies discussed their experiences with insourcing versus outsourcing, but transferring knowledge that is already gained by the agency to another area or program is a good practice. Transfer of technology and knowledge not only applies to motorized/non-motorized data collection, but also development of programs to use ITS technologies and using the already deployed ITS devices for data collection, or cataloging the data purchased from the third party vendors. SEMCOG is another good example of transfer of knowledge and technology by considering ways to use their knowledge gained in obtaining traffic data from smart sensors for collecting traffic data using cell phones and other probes in the future. SEMCOG is also on the cutting edge of traffic count and database software. Another forward-thinking approach of SEMCOG was noted as their ability to evaluate the compatibility of any data collected by using new technologies into their existing software before looking into data purchase or data collection agreements.

The importance of creating databases that are accessible by the public was another emerging trend among the agencies that were interviewed under not only Category 3 but also Categories 1 and 2. Although many state DOTs, MPOs, and local agencies already have similar databases, the City of Charlotte DOT

(CDOT) emphasized investing in such databases and gathering regional data, because they found that having the publically accessible database saved them staff time, who were spending considerable time fulfilling third party data requests otherwise. The City is working with MS2™ to continue the development of their database and make it available publically instead of fulfilling individual data requests from users and other agencies. Several agencies also indicated that they charge a fee for the data requests to compensate for the staff time and effort.

Although interviewed under the Category 2 TMS activities (Portable and Permanent Counts), Maricopa Association of Governments (AoG) had an interesting approach to the evolving technologies and availability of traffic data for purchase. The Maricopa AoG representative stated, “As [the industry] moves into new era of data, most agencies will be purchasing more and more commercially available data.” The rationale behind this thinking was that “as more and more data is available, it becomes a fraction of the cost of the agency’s in-house data collection.” Maricopa AoG is one of the first agencies to purchase a large INRIX™ data set. They contracted Texas A&M Transportation Institute (TTI) to evaluate speed data (for purchase) of a sample from a variety of vendors. Initially, the data appeared to be problematic, but industry advances have since improved data quality and reliability as an attractive alternative to collection.

Contracting college students for the completion of short-term seasonal counts prevented agencies from having to hire full-time staff members to complete counts that could only be conducted in the relatively short count season. Employing college students is relatively cost-effective when compared with hiring full- or permanent part-time staff members.

8.7 Perceived Advantages and Disadvantages of Other Contracting Methods

Nearly every agency interviewed indicated that non-traditional or innovative contracting methods are beneficial to their organization. While many only used these contracting methods primarily as supplements to their existing programs, this supplementation was widely viewed as being a positive. Constrains associated with staffing levels were often times cited as a factor for using the supplementation of new contracting methods, because these methods could assist the agencies in completing their required counts without hiring additional staff. Liability associated with assigning agency staff to perform work in the field was also cited as one of the reasons for utilizing external vendors for completing their TMS activities or purchasing data.

8.8 Summary of Findings - Category 3 Activities

Virtually, every interviewed agency was receptive to non-traditional and/or innovative contracting methods and they expressed their opinions about how beneficial these methods are. While agencies were often times concerned about the quality of the purchased data, nearly all of them indicated that they would be willing to implement new technologies if the quality were comparable to current methods and it offered time or money savings. Of the agencies that are already utilizing innovative contracting methods, these new strategies are overwhelmingly viewed as being a positive for the agency. Often times serving as a supplement to existing practices, these innovative contracting methods help agencies to complete required TMS activities under their fiscal and staffing constraints.

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.

As summarized in the interview with Nebraska Department of Roads (NDOR), 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.

8.9 Conclusions - Category 3 Activities

Innovative or non-traditional contracting methods can have many benefits for agencies conducting TMS activities. While currently acting as a supplement to existing counts and practices, agencies are largely receptive to further adopting new technologies. Agencies are concerned, however, about the quality of the product they will be receiving and seek verification of QA/QC procedures either similar or stricter than their own. Agencies also seek a cost savings associated with these new methods as the decisions to adopt them are largely made by upper management.

8.10 Recommendations - Category 3 Activities

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, as NDOR indicated, at one point in the future, it could be more feasible to outsource the 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 mentioned by the Maricopa AoG "As [the industry] moves into new era of data, most agencies will be purchasing more and more commercially available data. 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.

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.

9.0 SUMMARY OF REPORT FINDINGS

The following sections summarize all the noteworthy findings under this research effort as discussed in the previous sections.

9.1 Demographics of the Participating Agencies

- Out of the 79 unique responses collected, 41 were from state DOTs, 32 from MPOs, and the remaining six from the local transportation agencies. The majority of responses were provided by TMS managers, followed by supervisors and data processors, respectively.
- The responding agencies owned a varying number of continuous counting stations (CCS) in the range from less than 50 to more than 300.
- The responding agencies who owned WIMs indicated that they owned a varying number of weigh-in-motion (WIM) stations in the range from less than 10 to more than 100.
- The state DOTs undertake anywhere between 2,500 and 15,000+ short-term counts per annum, whereas the number of annual MPO and local agency counts are in the hundreds.
- Resourcing for Category 1 (Permanent Sensor and/or Equipment Installations) TMS activities, 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 TMS activities in Category 1.
- Resourcing for Category 2 (Portable and Permanent Counts) TMS activities 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.
- Resourcing for Category 3 (Other Contracting Methods) TMS activities was an even split among local agencies for fully/mostly insourcing and fully/mostly outsourcing their TMS activities. Both state DOTs and MPOs tended toward fully or mostly insourcing their Category 3 TMS activities.
- The majority of the state DOTs, for all three categories, indicated that their in/outsourcing practices had been in effect for greater than 15 years with a large portion indicating the current practices had occurred for over 20 years. The MPOs and local agencies were more divided in the historical pattern of their in/outsourcing practices, with no clear trend being exhibited.
- When asked about consultant contracts for TMS data collections:
 - Twenty-six state DOTs reported that they had these contracts, while 14 reported that they did not.
 - Fourteen MPOs reported that they had these contracts, while 16 reported that they did not.
 - Three responding local agencies reported that they had these contracts, while three reported that they did not
- When asked about their current staffing levels:
 - State DOTs reported an average of 10.9 full-time staff members for TMS activities and an average of 2.2 part-time staff members. Among these, the highest number of full-time staff members was 30 (California) and the lowest was one (District of Columbia and Delaware).
 - MPOs reported an average of 1.5 full-time staff members dedicated to TMS activities and 0.6 part-time staff members.
 - Local agencies reported an average of 1.8 full-time staff members dedicated to TMS activities and 0.8 part-time staff members.

9.2 Observed Trends on the Data Collected using the Web-based Assessment

9.2.1 Staffing Levels and Resources

- The full-time staff numbers of the agencies that outsource their traffic count activities are generally lower than the agencies that insource those activities. It is difficult to discern if the staffing level for outsourcing agencies is lower due to the activities being outsourced and there is reduced need for staff, or if the reduced staffing levels at the beginning necessitated the decision to outsource.

9.2.2 Resourcing Profiles for TMS Activities by Agency Type

- When the agency types and activities under the three categories are combined, it can be observed that the insourcing-to-outsourcing ratio is approximately 1.55.
- The state DOTs practice insourcing for approximately 63.2 percent of their traffic monitoring activities, MPOs practice approximately 56.8 percent, and local agencies approximately 48.8 percent.

9.2.3 Quality Assurance and Quality Control (QA/QC) Process

- When asked about the presence of a documented QA/QC process (regardless of their agency's resourcing practice), 87.5 percent of the state DOTs responded indicating that they have a documented QA/QC process, followed by the MPOs and local agencies by 53.3 and 28.5 percent, respectively.
- When the responses to the documented QA/QC procedures were evaluated based on the agencies' resourcing practices, the distribution among the insourcing and outsourcing agencies is almost a dichotomous, regardless of the type of the agency.
- When asked about the details of the "documentation" during the interviewing process, agencies referred to a variety of documentation such as internal QA/QC manuals, manufacturers or software vendors' specifications, calibration and data quality manuals, as well as the sections dealing with QA/QC procedures included in the contract documents

9.2.4 Decision-making Process

- Despite the long history with their current in/outsourcing practices, the majority of the agencies, regardless of type, had no formal or documented decision making processes.
- Regardless of the agency type, outsourcing agencies appear to have higher documented decision-making processes for their portable manual counts when compared to the other types of activities.
- Approximately 48.0 percent of the outsourcing agencies indicated that they have a documented process for their decisions regarding portable counts, and only 21 percent of the insourcing agencies verified that they have documentation for the decisions for the same activity.
- 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.
- When all the categories are combined, the agencies identified "agency, department, or division director/manager" as the predominant group of decision-makers for their in/outsourcing practices by 46.5 percent, followed by the "TMS program director/manager, team leader, or staff" group by 34.7 percent, and "a team of agency staff" by 18.8 percent.

9.2.5 Current Year Budgets

- DOTs have more funding budgeted for their TMS activities under the three categories, where the MPOs and local agencies have significantly lower budgets. The reported current annual budgets are predominantly in the \$100,000-\$500,000 range for the state DOTs.
- Ninety-four percent of the agencies who responded to the budget questions indicated that they spend 100 percent of the allocated annual budget on the data collection or equipment installation tasks.

9.2.6 Most-recent Six Year Budget Trends (2010-2015)

- The annual budgets for the “intrusive CCS sensor installation” and “CCS and equipment controller cabinets or complete CCS site installation” remained steady with slight increases for the mostly outsourcing and mostly insourcing agencies’ budgets, and a slight but steady decrease in the fully outsourcing agencies’ budgets.
- Although the budget trends for the insourcing and mostly outsourcing agencies remained somewhat unchanged, the budgets of the fully outsourcing agencies for site installations show a steady decrease from \$1.5M in 2010 to \$1.0M in 2015.
- The budgets for portable and permanent counts under all four types of resourcing profiles remained somewhat steady, except a surge in fully outsourcing agency budgets that occurred in 2014. However, the reason for the surge cannot be explained by evaluating the data that was collected.
- While the budgets for the outsourcing and mostly insourcing agencies remain constant between \$1.0M and \$1.5M per year, it appears that the budgets for weight measurement activity has been steadily increasing for the fully-insourcing agencies since 2010 from approximately \$250,000 in 2010 to approximately \$1.4M in 2015.
- Under the Category 3 activities, except a few labor-based activities (coordination, management) and publication of data/information, the majority of the fully-insourcing agencies’ budgets show an increasing trend between 2010 and 2015.
- The most-recent six-year budgets under the Category 3 activities remained steady for the fully outsourcing agencies, except for the category of “Management and Quality Control of Data Feeds into Regional Transportation Data Portals/Archives,” where a significant increase was observed between 2012 and 2015.

9.2.7 Evaluation of Reported Unit Costs

- The unit cost evaluations were based on limited number of data points obtained from nine agencies, where the maximum number of responses under an activity was seven (7). Even though the data is limited, the following consistent patterns for the aforementioned three activities were observed:
 - Short-period portable classification counts - For the 48-hour short-period portable classification counts, there was a significant difference observed in the unit prices. The average unit price for this activity type was calculated as \$975 for the outsourcing and \$316 for the insourcing agencies. For the 7-day short-period portable classification counts, the average unit price was calculated as \$1,900 for the outsourcing and \$716 for the insourcing agencies.
 - Short-period portable volume counts - For the 48-hour short-period portable volume counts, there was a significant difference observed in the unit prices. The average unit price for this activity type was calculated as \$875 for the outsourcing and \$350 for the insourcing agencies. For the 7-day short-period portable volume counts, the average unit price was calculated as \$1,800 for the outsourcing and \$816 for the insourcing agencies.

- Short-period portable classification/volume/speed counts – Some agencies use this type of vehicle classification and speed cross-tabulations. For the 48-hour short-period portable volume counts, there was a significant difference observed in the unit prices. The average unit price for this activity type was calculated as \$300 for the outsourcing and \$500 for the insourcing agencies. For the 7-day short-period portable volume counts, the average unit price was calculated as \$925 for the outsourcing and \$816 for the insourcing agencies.
- The total cost of performing the TMS activities in-house also includes full- and part-time staff, mileage, vehicle and equipment capital and depreciation costs, fixed overhead, and recurring operational costs. Although not determined certainly, there is a possibility that the respondents did not include the total cost of their operations for performing the short-term portable counts using in-house resources. Examples about how to calculate total cost of operations for short-term portable counts is provided in the following Chapter.
- Further data collection and analyses are necessary in order to draw meaningful conclusions from comparing the insourced and outsourced unit costs of short-term portable counts and TMS activities in general.

9.3 Interviews with the Agencies

9.3.1 Category 1 Interviews (Equipment and Sensor Installation)

- Nearly every agency that was interviewed indicated that decisions regarding their agency's resourcing practices are made at a level of management higher than the agency department/office that is responsible for actually completing the TMS sensors and equipment installations.
- Many of the interviewed agencies experienced challenges resulting from staffing caps, inadequate staffing allocations, funding shortages, and other insufficient resources that forced them to resort to outsourcing sensor and equipment installations.
- 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 their equipment installations.
- 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. 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.
- Many of the agencies that outsource their equipment installation activities based on the cost-efficiency based decisions. However, based on the discussions during the interviews, the perception of cost-efficiency appears to describe "effective resource allocation" rather than "cost-efficiency of operations."
- Though many agencies are forced to outsource installations due to state-imposed constraints, there was not a consensus among agencies that outsourcing the equipment installation contracts diminish the quality of the installations or the resulting traffic count data and/or weigh measurements. Only one agency felt that outsourcing equipment installations lowers installation quality.

- Of the agencies that insource equipment and sensor installations, the perceived primary benefits of doing so is the relatively low cost compared to contractors, flexibility, and responsiveness of installation time, ability to maintain low staffing levels, and elimination of the need to maintain installation equipment.
- Agencies largely find it beneficial to have documented QA/QC procedures to reduce the impact of staff turnover, ensure data check consistency, and guarantee confidence in the final data product. Agencies also largely find it beneficial to have established and documented installation warranties in place, but that many issues with faulty installations can be preempted by having a robust inspection process in place.

9.3.2 Category 2 Interviews (Permanent and Portable Counts)

- Nearly every agency that was interviewed indicated that decisions regarding their agency's resourcing practices are made at a level of management much higher than the agency department that is responsible for actually completing the agency's portable and permanent counts. Many of the agencies interviewed who outsource their counts suffer from staffing caps, inadequate staffing allocations, funding shortages, and other insufficient resources that force them to resort to outsourcing.
- 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 diminishes the quality of the resulting count data.
- Many agencies have not undertaken a formal cost/benefit analysis or developed a formal decision-making process to undergo the resourcing practice that is best for their agency. Nearly every agency felt that their current resourcing practice yields a better quality product than it would otherwise. However, several agencies expressed safety concerns about the risks of having their in-house staff on the side of busy roadways to do counts, and in some cases, union rules actually prohibit staff from doing so.
- Those agencies that outsource their portable and permanent counts perceive that contractors are able to do counts quickly and significantly reduce the resulting count season. These agencies also benefit from not having to employ the in-house staff to perform the counts as well as not having to maintain the necessary count equipment continually. The primary benefit of completing counts in-house is a perceived increase in control of data and data quality. Agencies also cite the familiarity of in-house staff with historical traffic patterns in their area as being extremely beneficial to their TMS efforts and help to catch errors in data very quickly. The perceived negatives of outsourcing data collection for some agencies were a lack of control of the data and a relatively high cost compared to insourcing.
- A primary concern amongst agencies when considering insourcing counts is the safety of their staff who would be performing counts on the side of roadways. Union rules and the resulting job classifications can also be an issue for agencies considering changing to insourcing counts. Completing counts in-house also requires higher staffing levels and maintaining the necessary count equipment--which can be costly.
- Agencies largely find it beneficial to have documented QA/QC procedures to reduce the impact of staff turnover, ensure data check consistency, and guarantee confidence in the final data product.

9.3.3 Category 3 Interviews (Other Contracting Methods)

- Every interviewed agency was receptive to non-traditional and/or innovative contracting methods. Of the agencies that are already utilizing innovative contracting methods, these new strategies are viewed as being a positive for the agency.
- Often times serving as a supplement to existing practices, these innovative contracting methods help agencies to complete required TMS activities under their fiscal and staffing constraints.
- While agencies were often times concerned about the quality of the purchased product, nearly all of them indicated that they would be willing to implement new technologies if the quality were comparable to current methods and it offered time or money savings.
- 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.
- 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.

10.0 STRATEGIES FOR DECISION SUPPORT

For the purposes of this document, ‘outsourcing’ is used to describe activities that are fully or partially contracted to entities that are not affiliated with the outsourcing agency, and ‘insourcing’ is used to describe activities that are fully or partially performed by using an agency’s in-house (or internal) financial, human, and capital resources. In the cases of partial outsourcing or insourcing, activities in both categories occur at varying levels. Therefore, it is also important to identify and understand the factors that influence the decision behind choosing one method over the other. Informed decision-making processes for insourcing or outsourcing (or as they are referred as “make or buy” decisions) are specific to an agency or organization’s needs and objectives.

10.1 Decision-support Considerations for TMS Activities

This section provides steps for a recommended decision-making process for agencies conducting in-house activities or outsourcing, and the considerations about changing that process. Recommendations and methods do not include provisions regarding up- or downscaling the process and its elements based on the agencies’ size, resources, and/or needs. However, this document and the considerations included in this section are developed to provide a resource to the agencies to initiate communication with other agencies that appear to face the same challenges and discuss the methods that they deployed in order to address those challenges and increase the efficiency and effectiveness of their operations. **Figure 10-1** and **Figure 10-2** show some of the key considerations for insourcing and outsourcing that were emphasized by the agencies during the interviews, respectively.

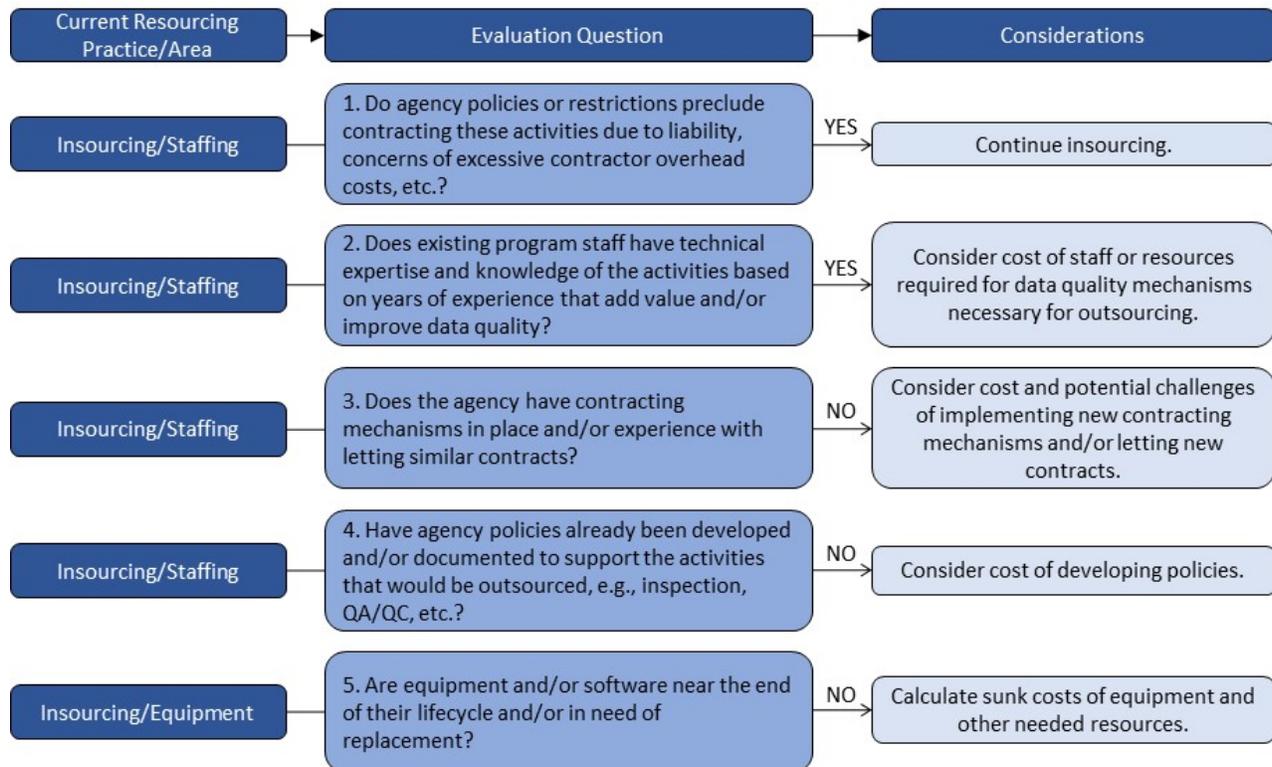


Figure 10-1. Insourcing Decision-support Process

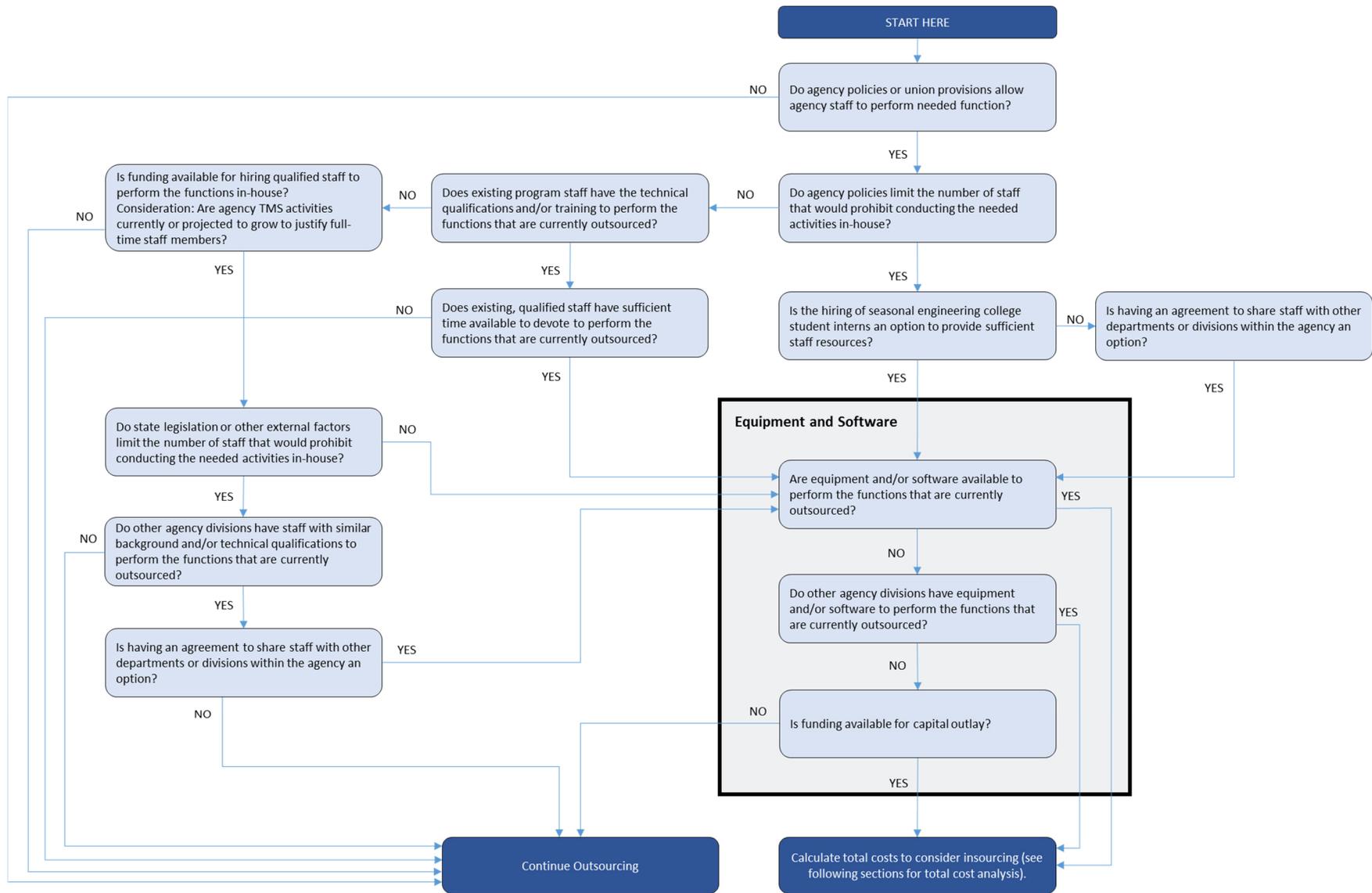


Figure 10-2. Outsourcing Decision-support Process

In addition to the aforementioned planning-level decision-support evaluations, a thorough decision-making process should involve an evaluation of advantages and disadvantages of the known resourcing options, as they apply to traffic monitoring system programs. The following sections summarize the factors that agencies use (or should consider) in supporting their decisions for insourcing and outsourcing. Following the support factors for each resourcing method, advantages and disadvantages of the resourcing methods are also listed based on the findings of the web assessment and the information that was gathered during the interviews. Finally, there are two factors listed as requiring in-depth analyses—cost and quality. The supporting factors, advantages, and disadvantages are agency-specific elements that are dependent on an agency’s perspectives, operational objectives, and desired standards. The cost and quality factors, on the other hand, require collection of data and evaluations/analyses in order to make an informed decision.

10.2 Supporting Factors, Advantages, and Disadvantages of Insourcing

10.2.1 Factors Supporting Insourcing

The following provides a general list of factors that would support insourcing of TMS activities:

- 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)

10.2.2 Advantages of Insourcing

By addressing the limitations or constraints listed above, insourcing provides general advantages in the following categories, where the majority of the advantages are applicable for institutional and organizational gains:

- 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

10.2.3 Disadvantages of Insourcing

Resourcing methods come with advantages and disadvantages. The following are the general disadvantages associated with insourcing TMS activities.

- 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)

10.3 Supporting Factors, Advantages, and Disadvantages of Outsourcing

10.3.1 Factors Supporting Outsourcing

Based on the foregoing evaluations of the collected data and interview responses, the following provides a general list of factors that would support outsourcing of TMS activities:

- 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

10.3.2 Advantages of Outsourcing

By addressing the limitations or constraints listed above, outsourcing provides general advantages in the following categories:

- 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

10.3.3 Disadvantages of Outsourcing

The following are the general disadvantages associated with outsourcing TMS activities.

- 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

10.4 Cost and Quality Factors for Insourcing or Outsourcing Decisions

In addition to the advantages and disadvantages, there are benefits and disbenefits associated with the selected resourcing method. The assessment of benefits/disbenefits would require more detailed evaluation and/or analyses. In addition to analyses, the determination of an action's benefits or disbenefits would also depend on the specific institutional and organizational operating and funding conditions of an agency, as well as the alignment of the selected resourcing methods with the agency's organizational missions and objectives. 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). In order to make an informed decision about the quality of data, the agencies need to have access to data that is collected using in-house resources and data that is supplied by contractors. As uncovered during the interviews with the select number of agencies, most of them do not have the necessary data to make a comparison. In those cases, agencies can contact several contractors and engage a task order-based contract to ask them to collect different types of data (e.g., classification, volume, speed, and classification-speed cross-tabulated data) at several control locations along different roadway sections. The data obtained from the contractors can be compared to the known values or to a new set of data collected by the agency staff at the same control locations. This process can be repeated several times throughout the year until the agency obtains adequate sample size

to analyze the variances between the sets of data and document the findings. Relevant QA/QC checks necessary to compare data sets, as well as QA/QC methods using case studies are provided in Appendix E section of the FHWA Traffic Monitoring Guide (2013)¹⁵ or the Quality Control/Quality Assurance section of the FHWA Traffic Monitoring A Guidebook (2010)¹⁶.

- *Total cost analysis* - Cost of insourcing or outsourcing is favorable based on the total cost analysis that requires total cost analysis, which is discussed in the following section in detail and a sample cost evaluation worksheet provided by PennDOT is included in *Appendix H*.

10.4.1 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. Total cost analyses are different from benefit-cost analyses, where the cost and benefit of the resourcing can be identified, monetized, and benefits are compared to the costs to develop a benefit-cost ratio. Ratios greater than “1.00” are considered beneficial and lower than “1.00” are considered not beneficial, where the degree of benefit or disbenefits is associated with the magnitude of deviation from “1.00.” In total cost analyses, an organization develops a very detailed and accurate estimate of the costs associated with both resourcing methods and compares the cost of one resource to the other one to understand if there is a net financial gain or loss by choosing either one of the resourcing methods.

In order to understand the financial advantages and disadvantages of in/outsourcing, a formal total cost analysis can be performed. This type of analysis would allow any agency to be able to compare the costs associated with the insourcing of the activities, especially the short-term portable counts, 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. After the entire cost of running the program with in-house capabilities is established, the cost can be divided by the annual number of counts conducted under the program. This would allow the agency to determine the “unit cost” of the short-term portable counts. After the insourcing unit cost is determined, the average unit cost per short-term count can be obtained from the most-recent task orders under the current contracts. The cost of count and any direct costs such as mileage, travel expenses, purchase of accessories such as tubes, clamps, etc. should be considered in calculating the unit cost when the activity is outsourced.

Table 10-1 shows the items that are to be included in a typical cost estimate for short-term portable count activities. *Table 10-1* was developed to provide the level of detail needed for a thorough total cost analysis for insourcing short-term portable counts. Before undertaking detailed cost analyses, analysts could prefer to run a high-level (or planning level) evaluation, where the cost of certain elements can be estimated as a lump sum (e.g., annual budget for vehicle maintenance, cost for tools, etc.). It is also recommended that approximately five percent contingency added to budget for equipment and tool replacement in the future.

¹⁵ http://www.fhwa.dot.gov/policyinformation/tmguidetmg_fhwa_pl_13_015.pdf

¹⁶ <http://flh.fhwa.dot.gov/innovation/publications/Other%20Publications/wflhd/traffic-monitoring.pdf>

Table 10-1. Typical Cost Items for Short-term Portable Traffic Counts

Cost Category/Item	Unit	Approx. Unit Cost	Sources (also see footnotes) and Guidelines for Extension of Unit Cost
Workforce			
Full-time staff salary*	Hour	\$25	Field technician. Include hours for training and certification.
Part-time staff salary*	Hour	\$22	Field technician (seasonal or permanent part-time). Include hours for training/certification.
Staff hours (field supervision)*	Hour	\$35	Senior field technician -field checks of initial installation and periodic monitoring.
Staff hours (data processing)*	Hour	\$26	Technician to download, tabulate, verify, upload data into system.
Staff hours for QA/QC*	Hour	\$40	Engineer for QA/QC of data and testing/calibration of equipment in the field.
* The hourly wages are estimated using averages from various online sources. For ease of reference, the hourly wages can be adjusted for each state using <i>AEI Economic Policy Working Paper</i> (¹⁷) 2014-04 - Table 3 on page 58 (https://www.aei.org/wp-content/uploads/2014/04/-biggs-overpaid-or-underpaid-a-statebystate-ranking-of-public-employee-compensation_112536583046.pdf) or the online tool by The Pew Charitable Trust on <i>Comparing State Salaries to Private Pay</i> (http://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2013/07/02/comparing-state-salaries-to-private-pay).			
Operational			
Equipment			
Portable counters	Each	\$1,000	Approximate cost of PEEK®™ ADR-1000 Plus™ Portable Traffic Counter/Classifier ¹⁸ .
Hand-held counting boards	Each	\$800	Approximate cost of JAMAR Technologies® TDC Ultra™.
Calibration machine	Each	\$750	For testing and calibrating portable counters in office settings. One per office location.
Extra batteries	Each	\$75	If the portable counter units are not solar-powered.
Other Non-recurring			
Cell phone device (Smartphone)	Each	\$150	Approximate cost of Samsung® Galaxy Core Prime™ ¹⁹ . One per crewmember.
Car charger for cell phone	Each	\$20	Estimated average cost from retailers ²⁰ . One per vehicle.
Work van or SUV	Each	\$35,000	Approx. cost of 2014 Ford® E350 Super Duty™ ²¹ (does not include financing costs).
Software for counter programming and data processing	Per license	\$500	The majority of the software is free of charge with equipment purchase. One per computer used in programming the portable counters and used for data processing.

¹⁷ Biggs, A.; Richwine, J. 2014. *Overpaid or Underpaid? A State-by-State Ranking of Public-Employee Compensation*, American Enterprise Institute for Public Policy Research.

¹⁸ Source: PEEK Traffic (http://www.peek-traffic.com/products_data.php) accessed on March 2016

¹⁹ Source: Verizon Wireless® (<http://www.verizonwireless.com/smartphones/samsung-galaxy-core-prime/>) accessed on March 2016

²⁰ Source: Amazon.com® (<http://www.amazon.com/cell-phone-car-chargers/b?ie=UTF8&node=2407770011>) accessed on March 2016

²¹ Source: Ford® online inventory (<http://www.inventory.ford.com/>) accessed on March 2016

Assessment of Insourcing/Outsourcing Practices for Traffic Monitoring Data Collection
 Final Report – (April 2016)

Category/Item	Unit	Approx. Unit Cost	Considerations/Sources (see footnotes for web links for sources)
Operational (continued)			
Recurring			
Monthly service plan – cell phone	Per line	\$100	Cost estimate based on known values from several service providers. One per cell phone.
Regular gasoline or diesel fuel for vehicles	Gallon	\$2.07 or \$2.12	March 2016 U.S. average cost of diesel fuel (https://www.eia.gov/petroleum/gasdiesel/). Divide miles for each vehicle by vehicle’s mileage rate (mpg), multiply by per-gallon cost of fuel, and sum up all the costs for each vehicle.
Vehicle insurance (annual)	Each	\$1,000	Average SUV insurance cost from AAA <i>Your Driving Costs – 2015</i> (http://exchange.aaa.com/wp-content/uploads/2015/04/Your-Driving-Costs-2015.pdf). One per vehicle.
License/registration fee + taxes (annual budget)	Each	\$830	Average costs for SUVs from AAA <i>Your Driving Costs – 2015</i> (http://exchange.aaa.com/wp-content/uploads/2015/04/Your-Driving-Costs-2015.pdf). One per vehicle.
Vehicle maintenance (annual budget)	Lump sum	\$1,000	Annualized cost of engine oil, coolant, brake fluid, transmission fluid, power steering fluid, air filter, belts, hoses, tires, battery, wiper blades from AAA <i>Your Driving Costs – 2015</i> (http://exchange.aaa.com/wp-content/uploads/2015/04/Your-Driving-Costs-2015.pdf). Use \$0.216 per mile for approximation of combined annual fuel and maintenance costs. One per vehicle.
Depreciation (annual)	%	N/A	Vehicle/equipment depreciation (for detailed estimations refer to IRS Publication 946 (https://www.irs.gov/pub/irs-pdf/p946.pdf), or for high-level estimations refer to AAA <i>Your Driving Costs – 2015</i> (http://exchange.aaa.com/wp-content/uploads/2015/04/Your-Driving-Costs-2015.pdf). Per vehicle/year for five years (or the expected lifespan of vehicle/equipment).
Rent for depot/facility (monthly)	Each	\$3,000	Estimated cost for traffic equipment and vehicle storage from PennDOT benefit-cost analysis spreadsheet (see <i>Appendix H</i>). One per location.
Telephone land line for facility	Per line	\$50	Estimated value for commercial telephone service. Monthly per facility.
Periodic equipment maintenance	Each	\$150	Cleaning and calibration of one portable counter by vendor. Annual per equipment.
Training and Certification	Each	\$50-\$900	Necessary training to use the equipment and safety certifications. American Traffic Safety Services Association (ATSSA) has training programs on traffic control and safety (http://www.atssa.com/Training) with a fee ranging between \$195 and \$565 for non-members. In addition, the National Highway Institute (NHI) has highway safety training (http://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&cat=18&res=1) with fees ranging between \$50 and \$900 per training module. Fees are per crewmember.

Assessment of Insourcing/Outsourcing Practices for Traffic Monitoring Data Collection
 Final Report – (April 2016)

Category/Item	Unit	Approx. Unit Cost	Considerations/Sources (see footnotes for web links for sources)
Accessories²²			
Road tubes (heavy duty)	Linear Foot (LF)	\$1.00	Heavy duty D-tube for high-volume roadways. Required length can be calculated by using the coverage formula as 12 feet per each lane plus the width of shoulder (use 10 feet if not known) and the length required to cover the distance for the counter to be placed on the roadside (use 10 feet if not known and coil the tubes in the field). Volume counts require single tube and classification counts require a pair of tubes with same length.
Road tubes (mini tube)	LF	\$0.50	Small-diameter O-tube for low volume roadways. Required length can be calculated by using the coverage formula as 12 feet per each lane plus the width of shoulder (use 10 feet if not known) and the length required to cover the distance for the counter to be placed on the roadside (use 10 feet if not known and coil the tubes in the field). Volume counts require single tube and classification counts require a pair of tubes with same length.
Masonry nails	Each	\$0.35	For securing the tube ends onto the roadway using webbing, Figure-8, or C-clamps. Nail lengths are 1", 1-1/2", 2", 2-1/2", and 3-1/2" but the cost per nail is the same. Webbing requires one, C-clamps two, and plate clamps require four nails + two screws.
Webbing	LF	\$1.00	To secure the end of the tube to the center or opposing side of the road, similar to C-clamp, Figure-8, or woven cable grip. Do not include in cost estimates if either one of the other securing accessory is used. Approximately 4 to 6" inch is needed for securing one tube end. Two webbings per tube (one for each end).
C-clamp	Each	\$0.75	To secure the end of the tube to the center or opposing side of the road, similar to webbing and Figure-8. Better suited for roadside securing and using webbing for the travel lanes. Do not include in cost estimates if either one of the other securing accessory is used. Two clamps per tube (one for each end); however, not preferred for centerline or in-roadway installation along the travel lanes.
Figure-8	Each	\$2.30	To secure the end of the tube to the center or opposing side of the road, similar to webbing, C-clamp, or woven cable grip. Do not include in cost estimates if either one of the other securing accessory is used. Two Figure-8s per tube (one for each end); however, not preferred for centerline or in-roadway installation along the travel lanes.

²² Source: All prices for the accessories are obtained from International Road Dynamics, Inc. (IRD™) (<https://peoplecounterstore.com/product-category/counter-accessories/>) accessed on March 2016 and CountingCars.com (<http://www.countingcars.com/Road-Tubes-s/90.htm>) accessed on March 2016.

Assessment of Insourcing/Outsourcing Practices for Traffic Monitoring Data Collection
 Final Report – (April 2016)

Category/Item	Unit	Approx. Unit Cost	Considerations/Sources (see footnotes for web links for sources)
Accessories²³ (continued)			
Woven cable grip	Each	\$3.85	To secure the end of the tube to the center or opposing side of the road, similar to webbing, C-clamp, or Figure-8. Better suited for roadside securing and using webbing for the travel lanes. Do not include in cost estimates if either one of the other securing accessory is used. Two grips per tube (one for each end); however, not preferred for centerline or in-roadway installation along the travel lanes.
End plug	Each	Brass: \$2.05 Plastic: \$0.60	Small-diameter O-tubes are typically knotted at the end, but the end plug adds extra certainty that there is minimal or no air leak from the end of the tube. Many technicians also use 1/4"-diameter screws instead of the end plug. One end plug per tube.
End plate	Each	\$6.15	End plate clamp is secured with four nails and two screws for anchoring tubes to the roadside asphalt or concrete. Typically used for high-volume installations. Do not include in the cost estimate if only low-volume roadways are in the TMS program. One end plate per tube.
Road tape	LF	\$0.15	To secure the tube to the roadway. Six-inch strips installed at 24- or 36-inch spacing along the tube and to cover the tube ends where nails are exposed on the travel lanes/centerline. Made of bituminous material to fuse to the roadway with heat and weight of the traffic traveling on it. Allow for one-foot strip for each 12-foot wide lane for high-volume, and six-inch strip for each 12-foot wide lane for low-volume roadways.
Chalk crayon	Box	\$10.00	To mark tube spacing, clamp locations, etc. in the field. One per crewmember.
Chalk line	Each	\$20.00	To mark straight line across the road as a guide for tube installation. One per crew.
Padlock	Each	\$15.00	For securing the chain ends. One per portable counter.
Chain	Each	\$20.00	Five-foot chain to secure the equipment to roadside guardrails, poles, light posts, etc. One per portable counter.

²³ Source: All prices for the accessories are obtained from International Road Dynamics, Inc. (IRD™) (<https://peoplecounterstore.com/product-category/counter-accessories/>) accessed on March 2016 and CountingCars.com (<http://www.countingcars.com/Road-Tubes-s/90.htm>) accessed on March 2016.

Assessment of Insourcing/Outsourcing Practices for Traffic Monitoring Data Collection
 Final Report – (April 2016)

Category/Item	Unit	Approx. Unit Cost	Considerations/Sources (see footnotes for web links for sources)
Safety Gear²⁴			
Hard hat	Each	\$15.00	One per crewmember.
Safety vest	Each	\$35.00	ANSI Class 3 vest. One per crewmember.
Safety light (amber)	Each	\$200.00	LED light bar for installation on vehicles. Minimum one per vehicle (please check the minimum requirements under your state's safety regulations).
Knee pad	Each	\$15.00	One pair per crewmember.
Glove	Each	\$5.00	One pair per crewmember.
Safety goggle	Each	\$4.50	One per crewmember.
First-aid kit	Each	\$115.00	American National Standards Institute (ANSI) Class B kit ²⁵ . One per vehicle.
Rain coat	Each	\$15.00	One per crewmember.
Tools			
Sledge hammer	Each	\$35.00	Double-faced non-sparking sledge hammer. One per crew.
Crow bar	Each	\$30.00	One per crew.
Utility knife	Each	\$10.00	Heavy-duty to cut road tape and tubes. One per crew.
Replacement blades	Each	\$0.10	Typically, provided in 10-pack. One per crew/vehicle.
Tape measure	Each	\$8.00	Metal casing to withstand drops on concrete/asphalt. One per crewmember.
Screwdriver	Each	\$5.00	One Philips and one flathead per crewmember.
Travel Expenses			
Hotel accommodations	Per day	\$80.00	Estimated value from online sources. Actual rates can be found on the General Services Administration's (GSAs) website: http://www.gsa.gov/portal/content/104877 . If no overnight travel is required based on coverage, do not include in the cost estimate. Cost needs to be one room per night per crewmember.
Overnight subsistence	Per day	\$41.00	Used PennDOT's 2014 per diem rate as an example (see <i>Appendix H</i>). Actual rates can be found on the General Services Administration's (GSAs) website: http://www.gsa.gov/portal/content/104877 . Please use your state's per diem rates for accurate cost estimates. Cost is per day per crewmember.
Mileage	Per mile	\$0.54	The standard mileage rate as published by the IRS is \$0.54 per mile. Please refer to IRS website for each year's published rates (https://www.irs.gov/Tax-Professionals/Standard-Mileage-Rates). Mileage is per crew traveling in the same vehicle.

²⁴ Source: All prices for the safety gear are obtained from Grainger®, Inc. (<https://www.grainger.com>) accessed on March 2016.

²⁵ ANSI/ISEA Z308.1-2015 - American National Standard Minimum Requirements for Workplace First Aid Kits and Supplies (http://www.ansi.org/news_publications/news_story.aspx?menuid=7&articleid=b4472a01-f4ac-4466-afd5-77559633a5f8)

10.5 Additional Considerations for Total Cost or Benefit/Cost Analysis Framework

In addition to the total cost analyses, agencies might also consider a set of benefits to understand the some of the values that cannot be monetized easily to be included in a total cost or benefit-cost analysis. These additional considerations are listed below.

- *Staffing*
 - Full-time in-house staff may incur reduce costs if responsibilities can be shared with other agency departments during off-season slow periods
 - In-house staff from other departments may be leveraged for infrequent activities, e.g., count station installation by traffic signal staff familiar with the necessary equipment
 - In-house staff with many significant experience may provide added value to a counting program
 - Interns may be hired for a part-time, temporary solution during summer season
 - Contractors may change staff fairly regularly, potentially resulting in staff unfamiliar with the area
 - Both new in-house and contracted staff may require increased oversight or inspection-related documentation, training, and QA/QC guidance from the agency
- *Equipment*
 - May be used very infrequently
 - Consider sharing with other agency departments
 - Rentals may be an option
 - Contracting may be more efficient than maintaining equipment in-house
- *Software*
 - In-house development capabilities could reduce costs
 - Off-the-shelf programs may provide efficiencies
 - Contractor staff may have more familiarity with common software used by other agencies
 - Agreements with universities to have qualified students code software programs for the agency

For agencies currently conducting in-house activities, outsourcing costs to consider include items that could be specified in the contract, but might result in higher rates contractor to reduce their risk.

Outsourcing costs to consider include:

1. *Contractor costs*
 - a. Contractor overhead costs
 - b. Timeliness / Responsiveness / Flexibility / Availability for program staffing needs
 - c. Costs of necessary training and development of QA/QC documentation
 - d. Ability to better control quality through gained agency staff knowledge
 - e. Ability to lower risk of changing contractor staff
 - f. Agency risk / liability
 - g. Count program size vs. need for dedicated staff
 - h. Documentation for inspection requirements
 - i. Warranty and recount policy for quality
2. *Inspection costs*
 - a. Agency staff time to review inspection-related documentation and/or be present in the field

3. *Equipment and resources*

- a. Sunk costs and value in software and resources that are familiar to agency staff
- b. Salvage value of existing equipment - The methodology to calculate the salvage value of any device/equipment can be borrowed from the Minnesota Department of Transportation's Benefit-Cost Analysis for Transportation Projects⁽²⁶⁾, which is primarily based on the American Association of State Highway and Transportation Officers (AASHTO) User Benefit Analysis for Highways⁽²⁷⁾. The equation is accepted by the industry as the most rational method to calculate the residual value of salvaged equipment and is applicable to the data collection equipment.

$$\text{Salvage Value} = \frac{(1+r)^n \times \left[\left(\frac{(1+r)^L - 1}{r(1+r)^L} \right) - \left(\frac{(1+r)^n - 1}{r(1+r)^n} \right) \right]}{\left(\frac{(1+r)^L - 1}{r(1+r)^L} \right)}$$

Where r = the discount rate (0.07)

n = number of years in the analysis period (10)

L = useful life of the asset

For agencies currently outsourcing, in-house costs to consider include:

1. *Hiring additional full-time staff or interns*

- a. Timeliness / Responsiveness / Flexibility for program needs
- b. Costs of necessary training
- c. Ability to better control quality through gained agency staff knowledge and experience
- d. Ability to lower risk of changing contractor staff
- e. Agency risk / liability
- f. Count program size vs. need for dedicated staff
- g. Ability to share staff with other departments
- h. Reduced inspection oversight needs

2. *Purchasing equipment and software resources*

- a. Count program size vs. need for equipment given estimated frequency of use

In summary, decisions regarding insourcing and outsourcing are dependent on agency-specific factors such as the technical capabilities, staff, training, policies, contracting needs, and equipment. It is important to note that there are some elements that are complex to measure and monetize such as the cost of better quality data, portions of the fixed overhead, equipment/tool lifespan and replacement costs, the long-term strategic implications/benefits of the resourcing decisions, or the importance of development of core competencies. Decisions regarding insourcing or outsourcing should also be well aligned with the strategic plan of an agency to ensure that associated processes or activities are well integrated with minimal disruptions along the process that is caused by the selected resourcing method.

²⁶ MnDOT. 2012. Planning and Programming: Benefit-Cost Analysis for Transportation Projects. <http://www.dot.state.mn.us/planning/program/benefitcost.html> (accessed March 2016).

²⁷ AASHTO. 2003. User Benefit Analysis for Highways. Technical Guidelines, Washington, DC: American Association of State Highway and Transportation Officers.

APPENDIX A – LIST OF ACRONYMS

ABJ35	TRB Standing Committee on Highway Traffic Monitoring
AADT	Average Annual Daily Traffic
ADT	Average Daily Traffic
ADUS	Archived Data User Service
AMPO	Association of Metropolitan Planning Organizations
ANSI	American National Standards Institute
ATSSA	American Traffic Safety Services Association
CCTV	Closed Caption Television
CCS	Continuous Counting Station
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
DAS	Database Administration Server
DOT	Department of Transportation
FHWA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Positioning System
GSA	General Services Administration
HPMS	Highway Performance Monitoring System
IDIQ	Indefinite Quantity Indefinite Delivery
IP	Internet Protocol
ITS	Intelligent Transportation Systems
MPO	Metropolitan Planning Organization
NACO	National Association of Counties
NACTO	National Association of City Transportation Officials
NATMEC	North American Travel Monitoring Exposition and Conference
NEPA	National Environmental Policy Act
NHI	National Highway Institute
PDF	Portable Document Format
PeMS	Performance Measurement System (CalTrans)
PII	Personally Identifiable Information
QA/QC	Quality Assurance/Quality Control
RITIS	Regional Integrated Transportation Information System
STIP	Statewide Transportation Improvement Program
TIP	Transportation Improvement Program
TMAS	Travel Monitoring Analysis System
TMS	Traffic Monitoring System
TRB	Transportation Research Board
U.S. DOT	United States Department of Transportation
WIM	Weigh in Motion

APPENDIX B - QUALIFICATION QUESTIONS

Introduction and Background

Research Objective

The primary objective of this research is to gather traffic monitoring system (TMS) data collection information on motorized vehicles from state DOTs, MPOs, and local agencies, and to document the advantages and disadvantages of in/outsourcing practices of traffic monitoring activities (fully, partially, or hybrid of the two). From this, we hope to gain insight into the rationale behind each agency's decision-making process in this regard. The end product will be a guideline document that summarizes findings and provides a systematic approach for the decision-making process involving the in/outsourcing of traffic monitoring activities.

For the purposes of this assessment, 'outsourcing' is used to describe activities that are fully or partially contracted to entities that are not affiliated with your agency and 'insourcing' is used to describe activities that are fully or partially performed by using your agency's in-house financial, human, and capital resources.

Process

Qualification Questions - There are two sets of questions in this assessment. The initial questions (Qualification Questions) are designed to assess if a particular agency meets certain criteria aligned with the objectives of this research. Once your agency's profile meets the qualification criteria, a second set of questions will be asked.

Detailed Questions - The second set of questions (Detailed Questions) are designed to assess the details of your agency's traffic data collection practices such as equipment installation, traffic counts, contracting, agreements, etc.

Agency Contact Information

* denotes that an answer is required to proceed to the next question

*** Please provide the following contact information.**

Agency	<input type="text"/>
Contact Person's First Name	<input type="text"/>
Contact Person's Last Name	<input type="text"/>
Contact Person's Title	<input type="text"/>
State/Province	<input type="text" value="-- select state --"/>
Email	<input type="text"/>
Phone	<input type="text"/>

Country (if other than U.S.)

*** What is your functional role within your agency?**

Other (please specify)

Qualification Questions - Agency TMS Activity Data

Please answer the following questions to the best of your knowledge. If you do not have the information readily available, please provide an approximate value/answer. If the question is not applicable to your agency/operations, please enter "0".

*** 1. How many continuous counting stations (CCS) do you have?**

*** 2. How many weigh-in-motion (WIM) stations do you have?**

*** 3. How many short-duration traffic counts does your agency collect on an annual basis (regardless of the type or source)?**

*** 4. Do you have consultant contracts for your agency's TMS data collection activities?**

Qualification Questions - Agency Resources for TMS

5. What is the number of full-time staff assigned to TMS activities?

6. What is the number of part-time staff assigned to TMS activities?

7. Does your agency own vehicles designated exclusively for TMS activities?

Qualification Questions - Agency's In/Outsourcing Practices

8. Please mark the level of insourcing/outsourcing for each of the TMS activities within the three main categories.

*** Category 1 - Permanent Sensor and/or Equipment Installation**

	Fully Insourced	Mostly Insourced	Mostly Outsourced	Fully Outsourced	N/A
A. Intrusive Continuous Counting Station (CCS) sensors	<input type="radio"/>				
B. CCS and equipment controller cabinets or complete CCS site installation	<input type="radio"/>				
C. Pull boxes (including lead-in wires and cables)	<input type="radio"/>				
D. Site installations including communication and power (including portable power sources)	<input type="radio"/>				
E. Non-intrusive sensor installation (e.g., radar, passive infrared, ultrasonic, acoustic, CCTV, SmartSensors™)	<input type="radio"/>				
Other (please specify below)	<input type="radio"/>				

Other (please specify)

*** Category 2 - Portable and Permanent Counts**

	Fully Insourced	Mostly Insourced	Mostly Outsourced	Fully Outsourced	N/A
A. Portable manual counts (video, in-person, or electro-mechanical)	<input type="radio"/>				
B. Volume counts, classification counts, speed measurements (intrusive and non-intrusive)	<input type="radio"/>				
C. Weight measurements (through permanent or portable WIM)	<input type="radio"/>				
Other (please specify below)	<input type="radio"/>				

Other (please specify)

*** Category 3 - Other Contracting Methods**

	Fully Insourced	Mostly Insourced	Mostly Outsourced	Fully Outsourced	N/A
A. Paying for quality data for a given time period (contractor obtained and <u>quality-controlled by contractor</u>)	<input type="radio"/>				
B. Paying for quality data for a given time period (contractor obtained and <u>quality-controlled by your agency</u>)	<input type="radio"/>				
C. Buying data from other sources such as GPS or probe-based data (e.g., INRIX™), or data collected by vendors using video detection (e.g., MioVision™)	<input type="radio"/>				
D. Equipment sharing techniques and agreements with other agencies	<input type="radio"/>				
E. Coordination of non-traditional sources to obtain counts such as data exchange/sharing agreements with other organizations or agencies, or interdepartmental agreements such as traffic data collected by ITS	<input type="radio"/>				
F. Integration of the TMS data into the agency's or regional Archived Data User Service (ADUS)	<input type="radio"/>				
G. Management and quality control of data feeds into regional transportation data portals/archives (e.g., RITIS®, iPeMS®, DriveNet™)	<input type="radio"/>				
H. Publication of annual TMS reports, traffic volume maps, trends, data tables, graphs, and GIS shape files	<input type="radio"/>				
Other (please specify below)	<input type="radio"/>				

Other (please specify)

Qualification Questions - Documentation (Quality and Decision Making Processes)

11. Do you have a documented quality control and quality assurance process (i.e., routinely followed procedures that are reviewed and updated periodically)?

12. Do you have a documented decision-making process for in/outsourcing of your TMS activities (i.e., routinely followed procedures that are reviewed and updated periodically)?

End of Qualification Questions

Thank you for completing the qualification questions. You have the option to proceed to the detailed questions or exit the questionnaire.

If you decide to answer the detailed questions and you do not have the required information readily available, you can leave some of the answers blank and return to the questionnaire at a later time when you have the specific information.

Your responses will be saved automatically and you can access this questionnaire any time by clicking on the link that was provided to you in the original email.

You can also change your answers at any time by accessing the questionnaire by clicking on the link that was provided to you in the original email.

*** Please indicate your choice below. Note: Please choose 'Yes' if you would like to browse the detailed questions before making a decision.**

- Yes, I would like to continue to the detailed questions section.
- No, please remind me later via email. *(We will send you a reminder email in several weeks to see if you would like to answer the detailed questions.)*

APPENDIX C – DETAILED QUESTIONS

Detailed Questions: Section A - Agency Operations

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

A1. What is your agency's current annual budget and spending for all TMS activities in their respective categories (insourced and outsourced combined)? *Please estimate if you do not have access to the current budget or contract documents.*

	Category 1 - Permanent Sensor and/or Equipment Installation	Category 2 - Portable and Permanent Counts	Category 3 - Other Contracting Methods
2015	<input type="text"/>	<input type="text"/>	<input type="text"/>

A2. What is your agency's historical annual budget and spending for all TMS activities in their respective categories for the past five years (insourced and outsourced combined)? *Please estimate if you do not have access to the current budget or contract documents.*

	Category 1 - Permanent Sensor and/or Equipment Installation	Category 2 - Portable and Permanent Counts	Category 3 - Other Contracting Methods
2014	<input type="text"/>	<input type="text"/>	<input type="text"/>
2013	<input type="text"/>	<input type="text"/>	<input type="text"/>
2012	<input type="text"/>	<input type="text"/>	<input type="text"/>
2011	<input type="text"/>	<input type="text"/>	<input type="text"/>
2010	<input type="text"/>	<input type="text"/>	<input type="text"/>

A3. How many vehicles are designated exclusively to TMS activities (if known)?

A4. Approximately how many miles are driven annually by all vehicles designated for the TMS activities (if known)?

A5. What is the approximate annualized cost associated with maintenance of the agency-owned materials and equipment?

A6. Does your agency keep track of the reliability measures of CCS (i.e., % of time in operation)?

A7. Does your agency temporarily suspend data collection activities during certain months or periods (i.e., winter, tourism season, school closings, etc.)?

A7a. Which data collection activities are temporarily suspended during those periods (except when data are needed specifically during those periods (e.g., Holidays) or during special events (e.g., athletic events, conventions, etc.)? Please select all that apply.

- Short-term counts (i.e., 48 hours or shorter)
- Long-term counts (i.e., continuous counts)
- Intersection counts (except when data are needed during the suspension period)

Other (please specify)

A8. Does your agency outsource data processing activities?

If yes, please describe.

A9. Does your agency outsource data reporting, GIS interface, web interface, and similar back-end activities?

A10. If your agency is currently outsourcing the majority of the TMS activities, do you think that your agency possesses the necessary technical capabilities to manage TMS activities in-house?

Detailed Questions: Section B - Quality Assurance/Quality Control (QA/QC)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

B1. Does your agency have documented quality standards for statistical accuracy of traffic data (i.e., routinely followed procedures that are reviewed and updated periodically)?

If yes, please describe.

B2. Does your agency have a documented process to ensure the quality of the count data during post-processing (i.e., routinely followed procedures that are reviewed and updated periodically)?

If yes, please describe.

B3. Does your agency require contractors/consultants to provide documentation for the quality control during data collection (field control, monitoring, sampling, etc.)?

If yes, please describe.

B4. Does your agency require contractors/consultants to provide documentation for equipment testing and calibration for ground-truthing during the period of performance?

If yes, please describe.

B4a. What is the required frequency of such periodic testing/calibration?

Other (please specify)

B5. Does your agency require contractors/consultants to have written quality assurance policies and/or specifications for post-processing of data (e.g., imputation, statistical methods, validation, comparison to historical data, etc.)?

B6. Does your agency have written policies or specifications in the contracts for requiring recounts (i.e., what are the thresholds for accepting/rejecting counts, how many recounts are allowed for the same location, what is the timeframe for a recount, etc.)?

If yes, please describe.

B6a. Approximately how many recounts occur during a typical calendar year (if known)?

B6b. What types of counts require the most recounts? *Please select all that apply.*

Volume

Classification

Speed

Intersection (turning movement count)

Other (please specify)

B7. Does your agency have a policy to inspect consultants' equipment, installation, and data processing facilities/equipment on the site or in the field?

If yes, please describe.

Detailed Questions: Section B - Quality Assurance/Quality Control (QA/QC) (cont'd)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

B7a. Does your agency perform on-site or field inspections (i.e., manual, road inventory, video, etc.)?

If yes, please describe.

Detailed Questions: Section B - Quality Assurance/Quality Control (QA/QC) (cont'd)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

B7b. Approximately how many on-site or field inspections does your agency perform annually?

Detailed Questions: Section C - Decision-making Process

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

C1. Does your agency have a defined process for decisions regarding outsourcing or insourcing of the TMS activities?

If yes, please describe.

Detailed Questions: Section C - Decision-making Process (cont'd)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

C1a. Is this a formal analysis process (i.e., documented with formal procedures and data requirements, as well as evaluation and decision-making criteria)?

Detailed Questions: Section C - Decision-making Process (cont'd)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

C1b. How would you describe this formal analysis process? (Please select the closest one that describes your agency's process or select "other" and provide details)

Other (please specify)

C1c. Is this a process based on institutional knowledge or documented procedures such as routinely followed procedures that are reviewed and updated periodically?

If yes, please describe.

Detailed Questions: Section C - Decision-making Process (cont'd)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

C2. For how long has this process been used?

C3. Any recent change(s)?

Yes

No

If yes, please specify

Detailed Questions: Section C - Decision-making Process (cont'd)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

C3a. Reason(s) for the recent change(s)? *(Please select all that apply)*

- New leadership
- Based on recent benefit-cost analysis results
- New evaluation tool (efficiency/effectiveness)
- New performance measures/requirements
- Performance improvement when compared to the old process
- Based on successful results of neighboring states
- Based on successful results of peer agencies
- No particular reason
- Funding
- Automation (e.g., use of computers and automation of systems to reduce staff hours)
- Hiring restrictions (e.g., temporary or permanent hiring freeze)

Other (please specify)

Detailed Questions: Section C - Decision-making Process (cont'd)

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

C4. Does your agency rely on the on-site consultants for data collection or processing?

C5. Did your agency ever evaluate the advantages/disadvantages of outsourcing versus insourcing?

If yes, please describe.

C6. Who is involved in the decision-making process for the TMS activities in your agency?(Your agency might use slightly different titles or different terms instead of "TMS", but please select the closest ones)

	Category 1 - Permanent Sensor and/or Equipment Installation	Category 2 - Portable and Permanent Counts	Category 3 - Other Contracting Methods
Agency director	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Department/division director	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Department/division manager(s)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TMS program director/manager	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TMS program team leader(s)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TMS program staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A team of agency staff (combination of directors, managers, team leaders, technical and maintenance personnel, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
N/A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Detailed Questions: Section D - Data Purchase, or Data and Equipment Exchange/Sharing Agreements

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

D1. Does your agency purchase data from third party vendors such as MPO-reimbursed, ITS data, data collected by use of video cameras, etc.?

D2. Does your agency have traffic data exchange agreements with other agencies/organizations (city, municipal, MPO, county, regional, private sector)?

D3. Does your agency have equipment exchange/sharing agreements with other agencies/organizations?

D4. Does your agency have inter- or intradepartmental data sharing/exchange agreements (e.g., ITS data that is shared by two or more departments)?

Detailed Questions: Section E - Contracting Practices

Please provide a copy of your agency's most recent request for proposal (RFP) or contract for equipment installation and/or data collection. These can be emailed to Steve Jessberger at Steven.Jessberger@dot.gov or Murat Omay at omay@battelle.org.

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

E1. How many years is the performance period of your agency's permanent sensor/equipment installation contract?

Other (please specify)

E2. How many years is the performance period of your agency's traffic data collection contract?

Other (please specify)

E3. What is the annual contract ceiling and actual spending on the installation and data collection contracts?

	Contract Ceiling	Actual Spending
Equipment Installation	<input type="text"/>	<input type="text"/>
Data Collection	<input type="text"/>	<input type="text"/>

E4. Does your agency have a warranty policy for installation of the continuous count stations (CCS) and associated traffic monitoring equipment/sensors?

E4a. If yes, how many years does the warranty typically cover?

Other (please specify)

E5. Does your agency have a policy to reimburse consultants for material purchased for counts requiring pneumatic tubes, clamps, securing devices, etc.?

E5a. If yes, please select the typical method for such reimbursements.

Other (please specify)

Detailed Questions: Section E - Contracting Practices

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

E8. Under the contracts for the most recent five years, what was the approximate average unit cost for each type of installation/count? Please use an approximation for the unit costs that are not readily available. The details/specifics of the units costs such as arterial vs. interstate will be obtained later.

	Sensor Type (if applicable)	Approximate Unit Cost
Continuous count station (CCS) installation (per lane)	<input type="text"/>	<input type="text"/>
Non-intrusive sensor installation (e.g., radar, passive infrared, ultrasonic, acoustic, CCTV)	<input type="text"/>	<input type="text"/>
Permanent weigh-in-motion (WIM) station installation (per lane)	<input type="text"/>	<input type="text"/>
Portable WIM station installation	<input type="text"/>	<input type="text"/>
Short-period portable classification count (48 hours)	<input type="text"/>	<input type="text"/>
Short-period portable classification count (7 days)	<input type="text"/>	<input type="text"/>
Short-period portable volume count (48 hours)	<input type="text"/>	<input type="text"/>
Short-period portable volume count (7 days)	<input type="text"/>	<input type="text"/>
Short-period portable classification/volume/speed count (48 hours)	<input type="text"/>	<input type="text"/>
Short-period portable classification/volume/speed count (7 days)	<input type="text"/>	<input type="text"/>
Intersection turning movement count (12 or 13 hours)	<input type="text"/>	<input type="text"/>
Intersection turning movement count (peak period)	<input type="text"/>	<input type="text"/>
Special counts (12-hour vehicle occupancy)	<input type="text"/>	<input type="text"/>
Special counts (peak period HOV lane)	<input type="text"/>	<input type="text"/>
Special counts (12-hour manual classification or CCS validation)	<input type="text"/>	<input type="text"/>

E9. Does your agency install or plan to install portable WIMs? *If yes, details will be obtained later.*

Detailed Questions: Section F - Software

Please skip the questions if you do not know the answer, do not have access to the required information, or if the required information is not readily available.

F1. Does your agency outsource the software for the CCS controllers (custom or vendor-supplied)?

Please specify the software

F2. Does your agency outsource the software for testing of equipment, equipment programming, data download and processing, QA/QC (custom by vendor, in-house software development, third party software warranty, etc.)?

F3. Do you have documented requirements/process (i.e., routinely followed procedures that are reviewed and updated periodically) for QA/QC of the electronic submittal/uploading of post-processed data to your agency's database ?

F4. How is the data processing and submittal to FHWA (HPMS) handled in your agency? *Please select all that apply.*

- Customized portal operated by agency staff (requires minimal/no post-processing of data)
- Customized portal operated by on-site consultants (requires minimal/no post-processing of data)
- Database operated by agency staff (requires post-processing of data)
- Database operated by on-site consultants (requires post-processing of data)
- No submittal required (local agencies and MPOs)

Other (please specify)

F5. Does your agency use data publishing software on the web and/or GIS integration for internal and external clients?

Please specify the software

F6. Does your agency require software documentation from the consultants that collect and process data?

If yes, please describe.

Contact Information

Thank you for participating in this assessment. If you have any questions or require additional information, please contact:

Steven Jessberger

U.S. DOT FHWA Office of Highway Policy Information

Email: Steven.Jessberger@dot.gov

Phone: (202) 366-5052

Address: 1200 New Jersey Avenue, S.E., Washington, DC 20590

Murat Omay

Battelle Memorial Institute

Email: omay@battelle.org

Phone: (703) 413-7823

Address: 1550 Crystal Drive, Suite 601, Arlington, VA 22202

APPENDIX D – MOST RECENT SIX-YEAR BUDGET TRENDS

The charts in the following figures present the distribution of the annual budgets over the past six years based on the agency resourcing for a particular activity. The data is based on a total of 27 responses (14 state DOTs, eight MPOs, and five local agencies).

Category 1 Activities (Equipment and Sensor Installation)

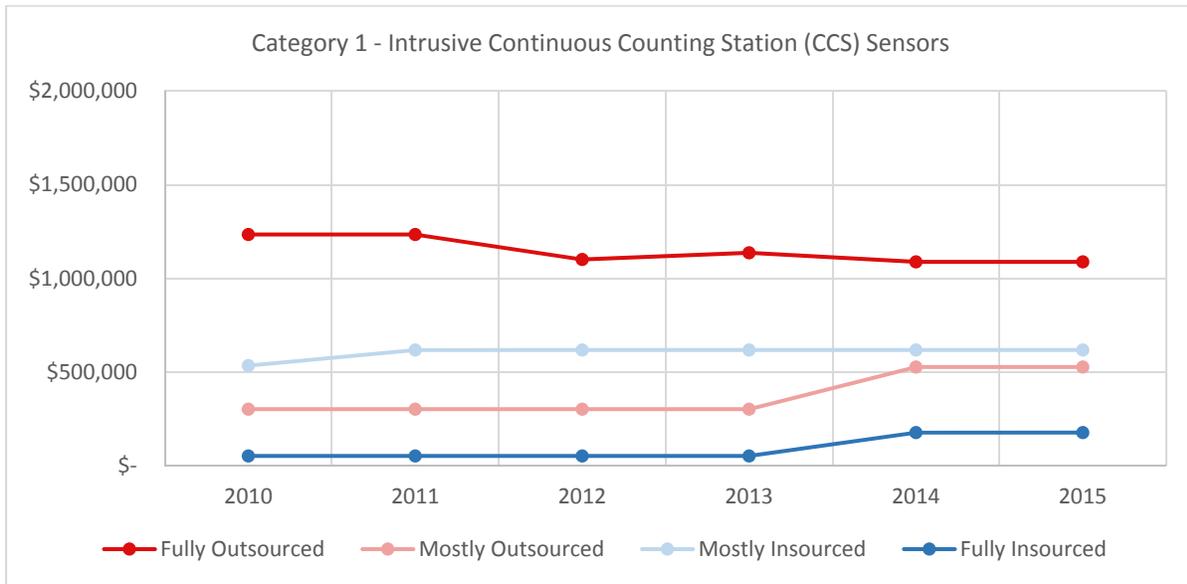


Figure D-1. Distribution of Annual Budgets – Category 1 (Intrusive CCS Sensor Installation)

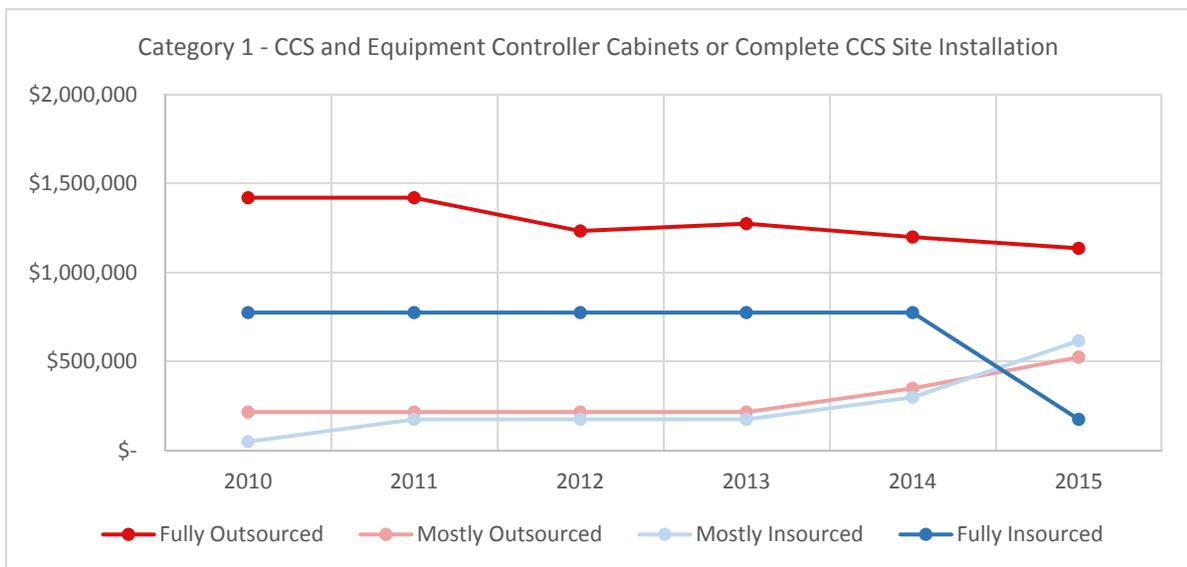


Figure D-2. Distribution of Annual Budgets – Category 1 (CCS and Equipment Controller Cabinets or Complete CCS Site Installation)

Based on the data trends in *Figure D-1* and *Figure D-2*, the annual budgets for the “Intrusive CCS Sensor Installation” and “CCS and Equipment Controller Cabinets or Complete CCS Site Installation” remained steady with slight increases for the mostly outsourcing and mostly insourcing agencies’ budgets, and a slight but steady decrease in the fully outsourcing agencies’ budgets.

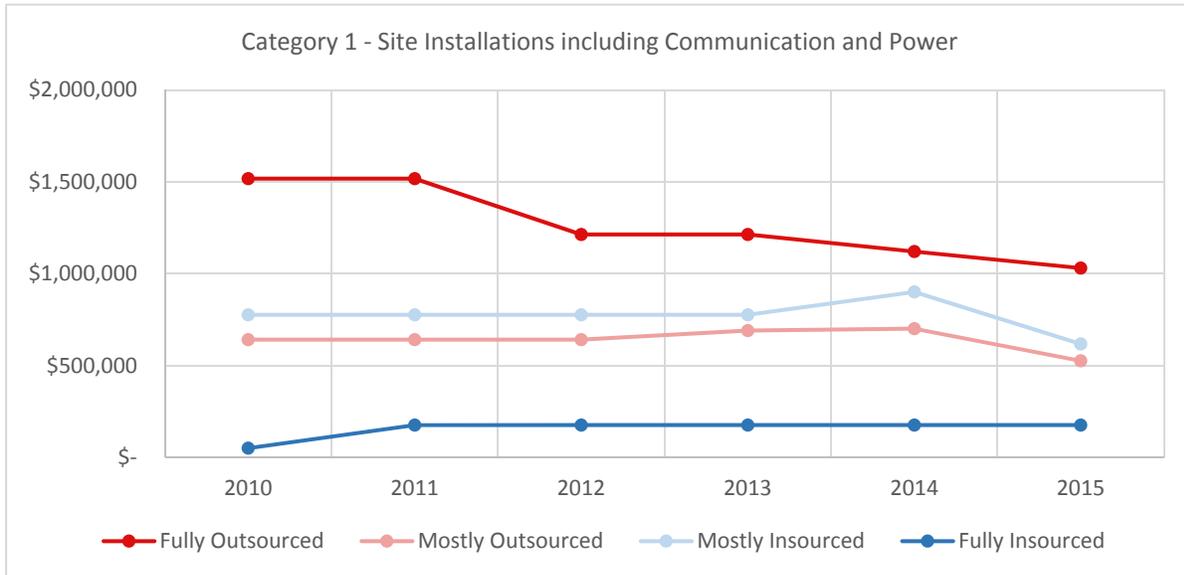


Figure D-3. Distribution of Annual Budgets – Category 1 (Site Installations including Communication and Power)

Although the budget trends depicted in *Figure D-3* for the insourcing and mostly outsourcing agencies remained somewhat unchanged over time, the budgets of the fully outsourcing agencies for “Site Installations” show a steady decrease from \$1.5M in 2010 to \$1.0M in 2015. Based on the data presented in the following *Figure D-4*, the same trend was also observed for the “Non-intrusive Sensor Installation” budgets of the outsourcing agencies.

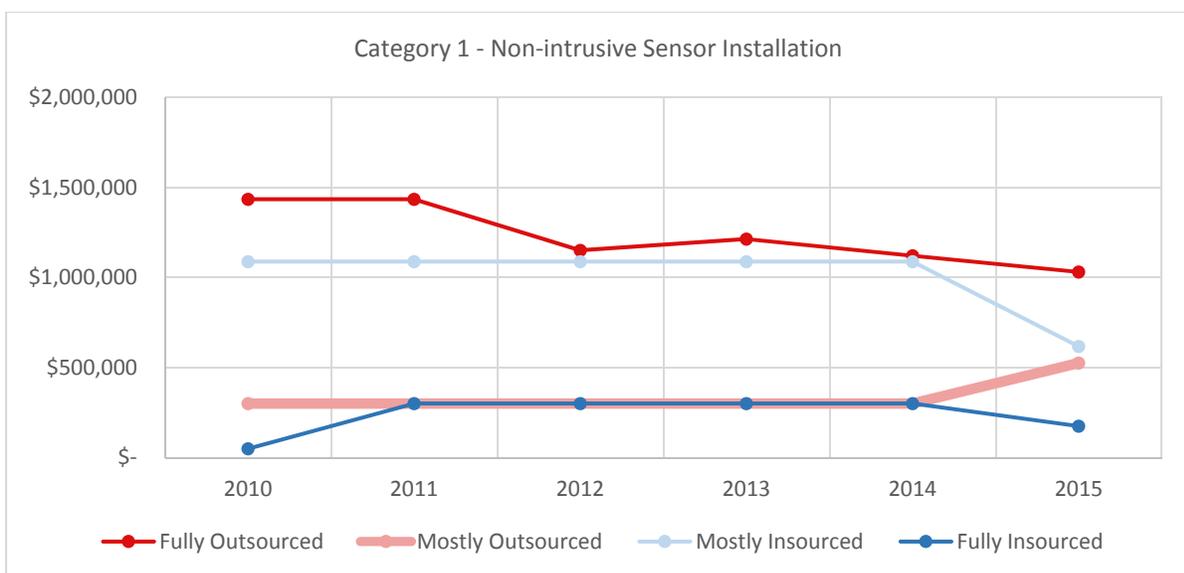


Figure D-4. Distribution of Annual Budgets – Category 1 (Non-intrusive Sensor Installation)

Category 2 Activities (Permanent and Portable Counts)

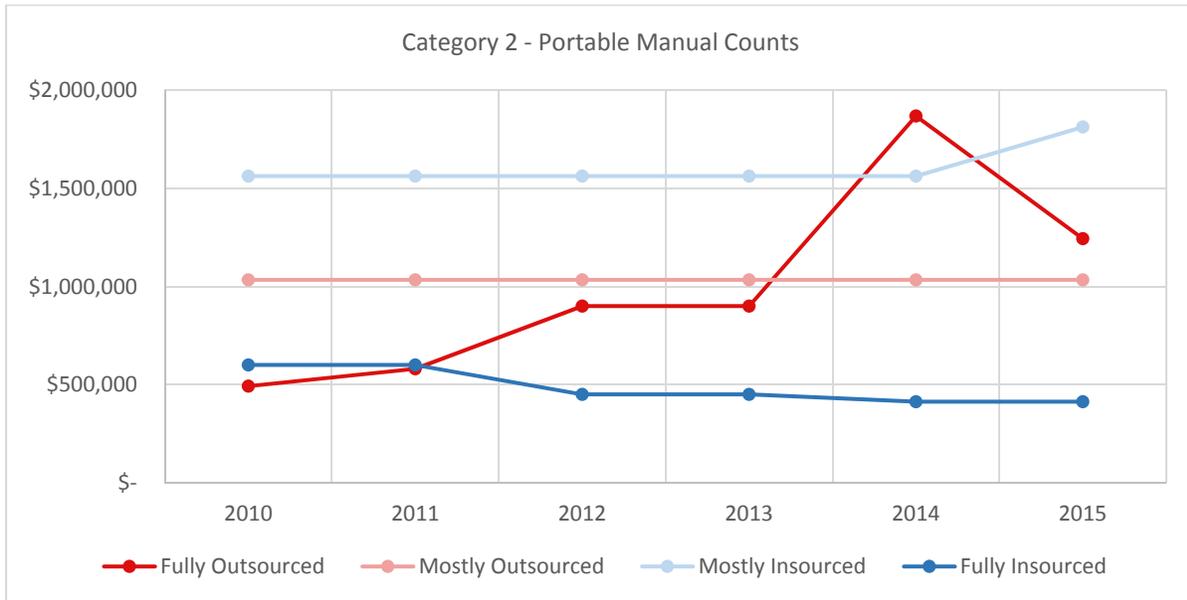


Figure D-5. Distribution of Annual Budgets – Category 2 (Portable Manual Counts)²⁸

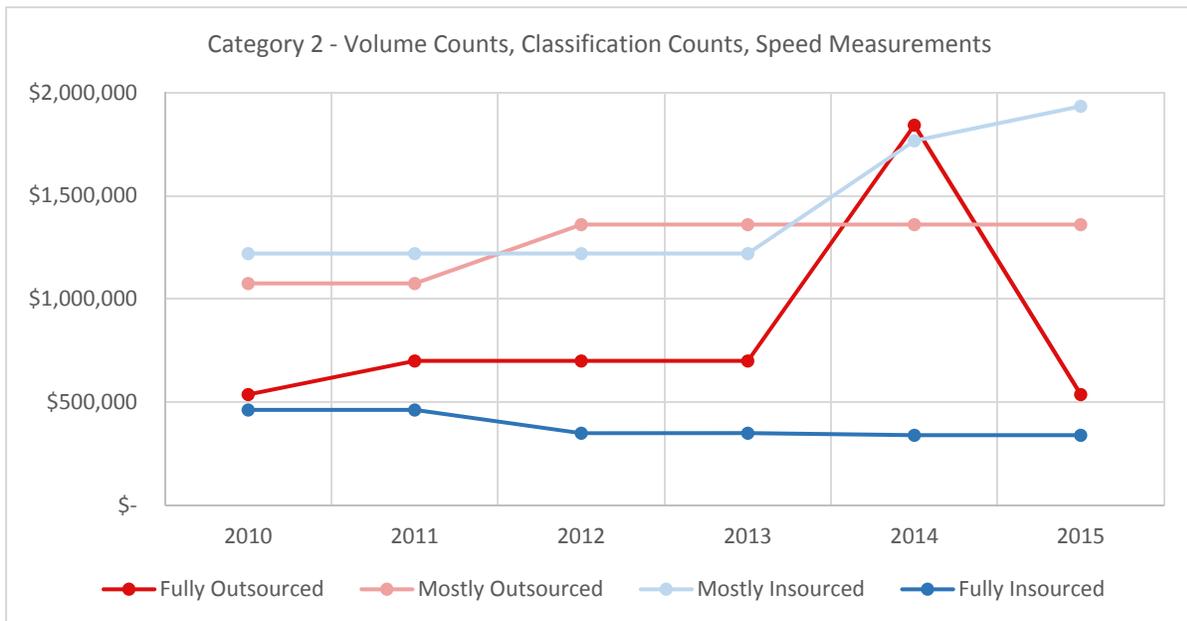


Figure D-6. Distribution of Annual Budgets – Category 2 (Volume Counts, Classification Counts, Speed Measurements)

²⁸ Note that one data point that reflects the surge in 2014 in *Figure D-5* and *Figure D-6* was adjusted using engineering judgment, because it was believed that a relatively high value was entered by one of the agencies by error, which had skewed the averages to be approximately \$6M in 2014.

The data trends presented in *Figure D-5* and *Figure D-6* show that the budgets for portable and permanent counts under all four types of resourcing profiles remained somewhat steady, other than an unexplained surge in fully outsourcing agency budgets in 2014. The majority of funding for the traffic data collection is provided by the FHWA; therefore, it was expected that budgets would remain steady over the most recent six-year period, unless changes were made with regard to Federal regulations and associated funding levels.

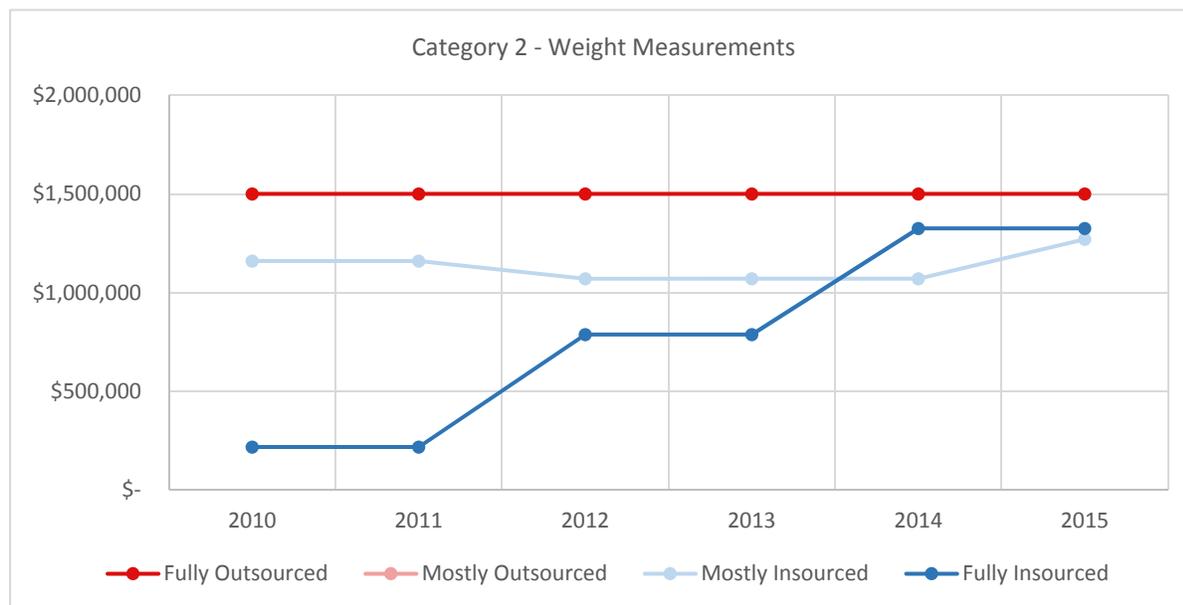


Figure D-7. Distribution of Annual Budgets – Category 2 (Weight Measurements)

While the budgets for the outsourcing and mostly insourcing agencies remained constant between \$1.0M and \$1.5M per year between 2010 and 2015, the data shows that the budgets for “Weigh Measurement” activity has steadily increased for the fully-insourcing agencies since 2010 from approximately \$250,000 to approximately \$1.4M in 2015.

Category 3 Activities (Other Contracting Methods and Activities)

The activities that were listed under Category 3 captured non-traditional contracting methods and activities to include equipment sharing agreements and data purchases from third party vendors. Data purchase agreements are categorized as “insourced,” mainly because they purchasing mechanism is managed internal to the agencies, even though the purchased data is collected by third parties. This is different from the data collected under TMS program contracts where the contractors are asked to collect data at specific locations during the periods requested by the agency. Purchased data is typically collected throughout the year by third parties and is sold to agencies at a later date. Since these activities are agency specific and the associated costs are dependent on many factors such as the amount of data, agreement conditions, and specifications of the purchased data, it is not feasible to observe specific patterns. However, the key observations on the budget data indicate that, except a few labor-based activities (coordination, management) and publication of data/information, the majority of the fully-insourcing agencies’ budgets show an increasing trend between 2010 and 2015. The budgets under the Category 3 activities remained steady for the fully outsourcing agencies, except for the category of “Management and Quality Control of Data Feeds into Regional Transportation Data Portals/Archives,” where a significant increase was observed between 2012 and 2015. This could be associated with recent trends of that agencies contracting out their data management and integration needs to outside vendors.

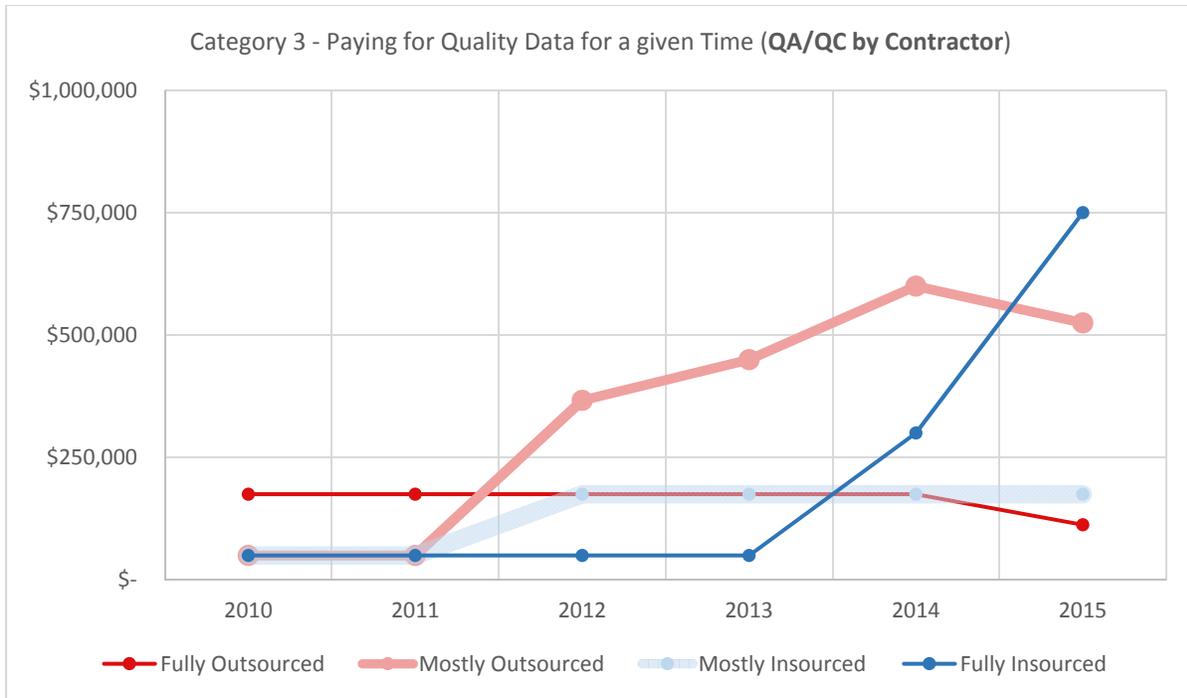


Figure D-8. Distribution of Annual Budgets – Category 3 (Paying for Quality Data for a Given Time – QA/QC by Contractor)

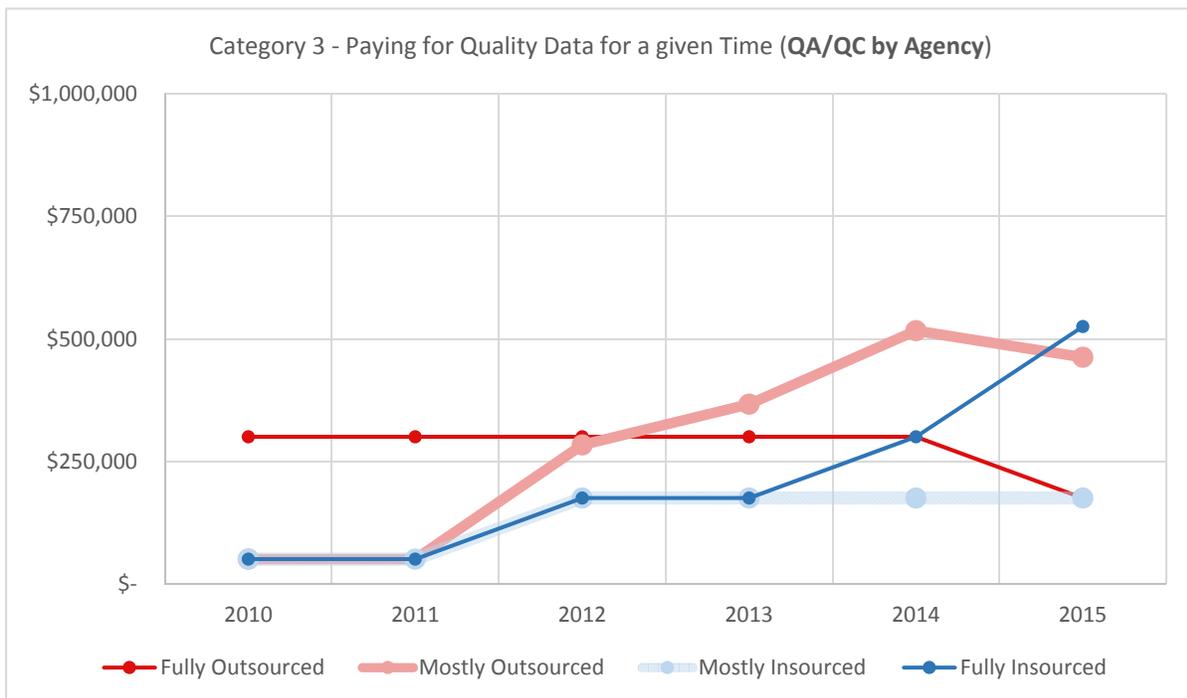


Figure D-9. Distribution of Annual Budgets – Category 3 (Paying for Quality Data for a Given Time – QA/QC by Agency)

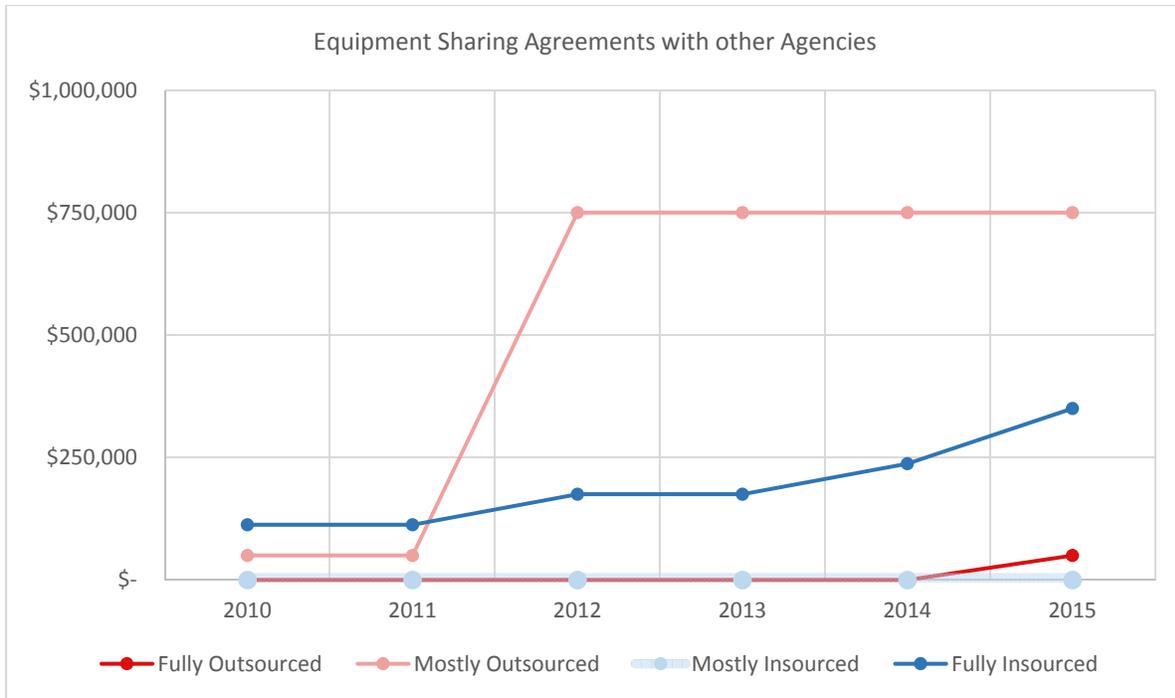


Figure D-10. Distribution of Annual Budgets – Category 3 (Equipment Sharing Agreements with Other Agencies)

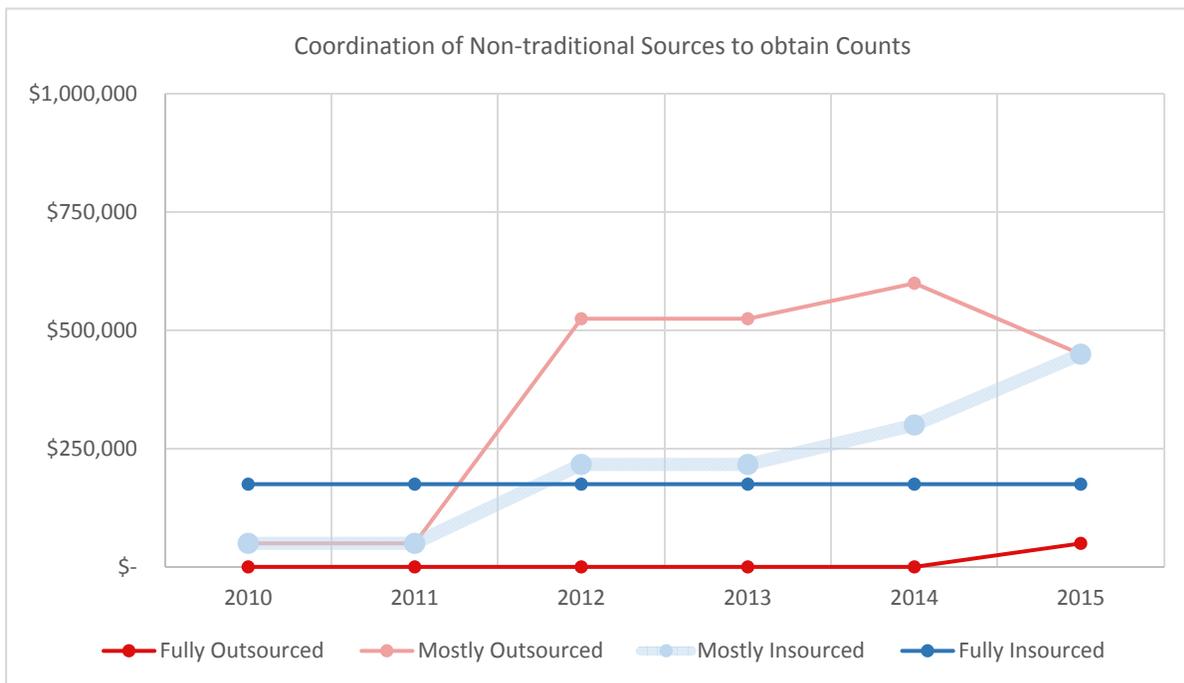


Figure D-11. Distribution of Annual Budgets – Category 3 (Coordination of Non-traditional Sources to Obtain Counts)

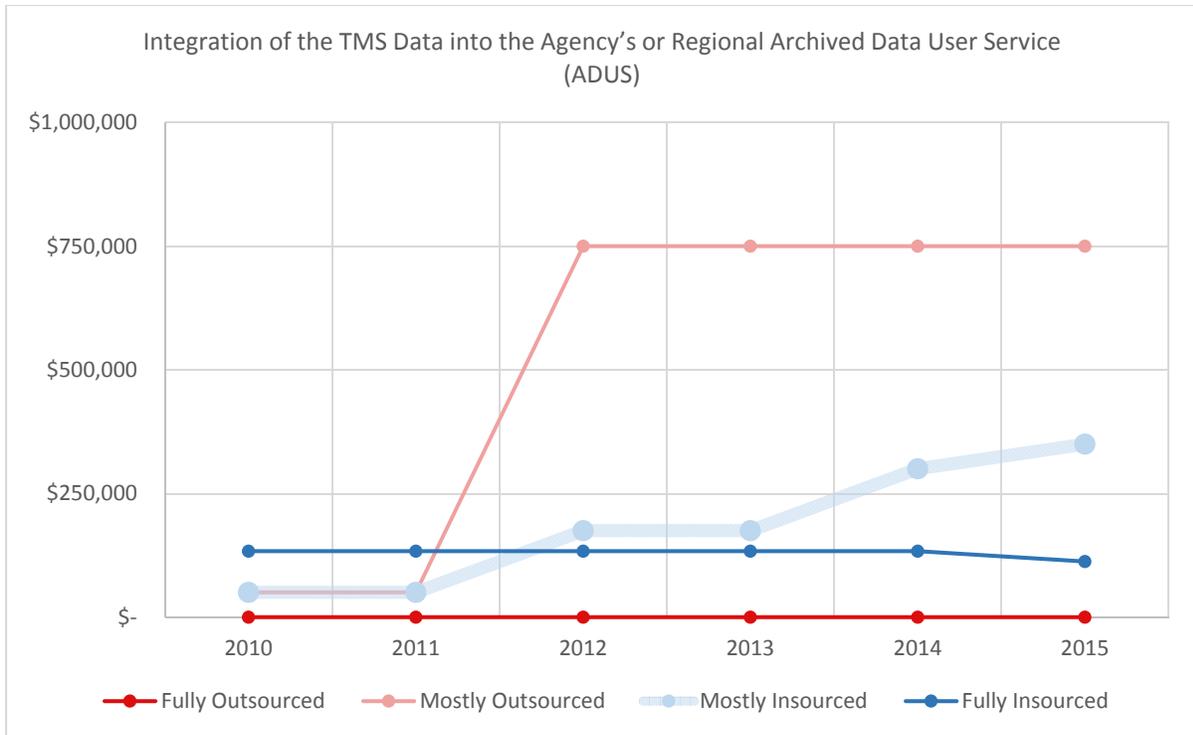


Figure D-12. Distribution of Annual Budgets – Category 3 (Integration of the TMS Data into the Agency's or Regional Archived Data User Service - ADUS)

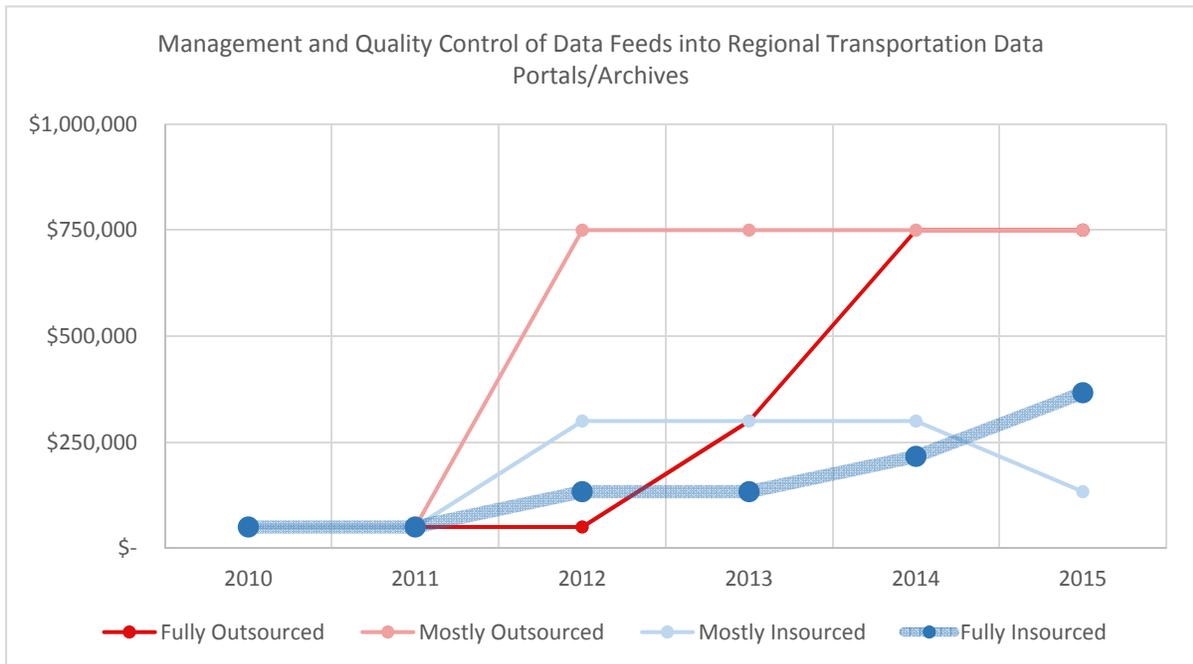


Figure D-13. Distribution of Annual Budgets – Category 3 (Management and Quality Control of Data Feeds into Regional Transportation Data Portals/Archives)

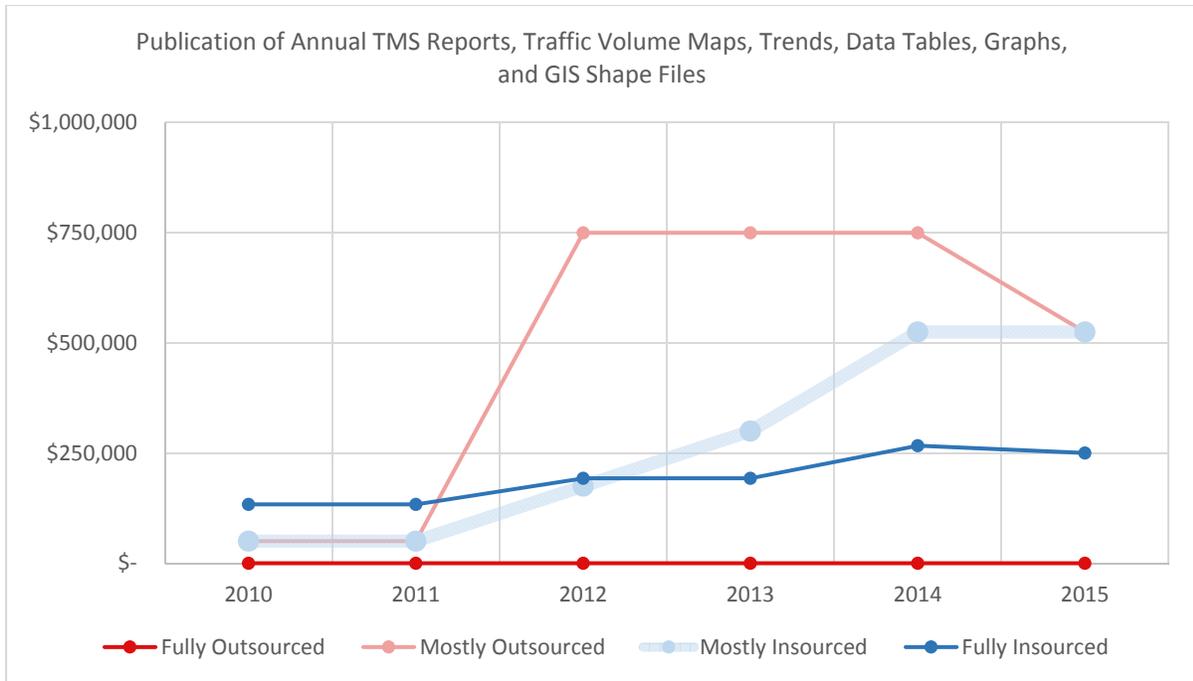


Figure D-14. Distribution of Annual Budgets – Category 3 (Publication of Annual TMS Reports, Traffic Volume Maps, Trends, Data Tables, Graphs, and GIS Shape Files)

APPENDIX E – AVAILABLE AND PROVIDED DATA FOR AGENCIES RESPONDING TO ONLINE ASSESSMENT

APPENDIX F – INFORMATION FOR SELECTED AGENCIES

APPENDIX G - INTERVIEW QUESTIONS

Assessment of In/Outsourcing Practices for TMS Category 1 Activities (Sensor and/or Equipment Installations)

Interview Questions

Organizational Practices

1. You indicated that your agency in/outsources sensor and/or equipment installations.
 - a. How many years have you been in/outsourcing the sensor and/or equipment installations?
 - b. What are the benefits of in/outsourcing of the sensor and/or equipment installations?
 - c. Do you have documented design standards for your equipment installations and can you share one?
 - d. Can you briefly describe your inspection process for equipment installations?
 - e. Are inspectors insourced or outsourced?
 - f. If you have had both insourced and outsourced inspectors, have you noticed a difference in quality of the installed equipment?
2. You indicated that your agency is currently outsourcing most of its sensor and/or equipment installations even though your agency possesses the necessary technical capabilities to manage TMS activities in-house. (Follow-up to A10)
 - a. Can you give some insight as to why your agency decided to outsource equipment installations when your agency possesses the capability to do installations in-house?
 - b. If you have experience with both in- and outsourcing, do you believe outsourcing equipment installations improves quality, lowers quality, or is about the same when compared to insourcing?
 - c. Are there any barriers that prevent your equipment installations from being completed in-house?
 - d. What are those barriers? Did you ever take actions to overcome the identified barriers? What were those actions?

Decision-Making Processes

3. Your agency has a defined process for decisions regarding [outsourcing/insourcing] of equipment installations. (Follow-up to 11 and C1).
 - a. Can you briefly describe this process?
 - b. Is it formalized? Is the process documented?
 - c. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties.)
 - d. Does this process work well for your agency?
 - e. How could it be improved?
 - f. How long has your agency been using this procedure?
 - g. Has it undergone any recent changes? If so, why?
 - h. How does your agency evaluate the advantages/disadvantages of outsourcing versus insourcing?
 - i. In a perfect world, how would this process be handled?
 - j. Who makes the final decision in this process?
 - k. How often, or what, would cause this decision to be reevaluated?
 - l. What would you change in the current process to make improvements?

Quality Assurance/Quality Control (QA/QC)

4. Your agency keeps track of the reliability measures of continuous count stations (CCS) and weigh in motion stations (WIM). (Follow-up to A6)

Assessment of In/Outsourcing Practices for TMS Category 1 Activities (Sensor and/or Equipment Installations)

Interview Questions

- a. Can you briefly describe this process?
 - b. What do the reliability measures cover (e.g. speed, volume, classification)?
 - c. How detailed are the measures (e.g., is the lane-by-lane percentage of availability recorded in an automated system)?
 - d. How is reliability measured? Is the system comparing the data to the historical data of the same detector zone or lane readings, or is the data compared to upstream and downstream detector data with an algorithm that balances the volume between the detectors?
 - e. What were/are the challenges with developing/tracking these measures?
 - f. What are the benefits of having reliability measures?
 - g. What would you change in the current process to make improvements?
5. Does your agency have a warranty policy for installation of the CCS and associated traffic monitoring equipment/sensors? (Follow-up to E4)
- a. If yes, how many years does the warranty typically cover?
 - b. Do you see it beneficial to have a warranty policy and what are the benefits of having a warranty policy in place?
6. Does your agency have documented requirements/processes for QA/QC for your equipment installations?
- a. Can you briefly describe those requirements/processes?
 - b. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties)
 - c. Do you see it beneficial to have a documented QA/QC policy? If yes, what are the benefits?
 - d. What would you change in the current QA/QC process to improve it or make it more effective/efficient?

Proposed Processes

The objective of the "Proposed Processes" section is to gather information that will be used in development of processes/matrices as part of the research recommendations, and the agencies that provided substantial input for this section will be asked to be contacted once more after the recommendations are drafted.

This section of the interview will involve open discussions regarding specific agency experiences associated with the processes based on the resourcing type of the agency, lessons learned from past programs/practices, etc., and focus on gathering feedback/input for potential processes that the research team has in mind. Examples include suggestions for process improvement measures, a decision-making process that could work for your agency (proposed but has not been implemented due a specific reason), or a process that you tried and refined after many iterations.

Assessment of In/Outsourcing Practices for TMS Category 2 Activities (Portable/Permanent Counts)

Interview Questions

Organizational Practices

1. You indicated that your agency in/outsources data collection activities.
 - a. How many years have you been in/outsourcing the data collection activities?
 - b. What are the benefits of in/outsourcing of the data collection activities?
 - c. Do you have documented procedures for data collection (regardless of who collects it)?
 - d. Did you ever compare the data quality for the periods when the data collection process was in- or outsourced (i.e., before-after comparison)? If yes, what were your findings/observations?
2. You indicated that your agency in/outsources data processing activities. (Follow-up to A8)
 - a. How long have you been in/outsourcing the data processing activities?
 - b. If your agency also in/outsources its data processing activities, is the data collection and processing consultants the same?
 - c. What are the benefits of in/outsourcing of the data processing activities?
 - d. How do you control the data quality?
 - e. Do you have documented procedures for data processing (i.e., formatting, imputing, and extrapolating)?
 - f. Did you ever compare the data quality for the periods when the process was in- or outsourced (i.e., before-after comparison)? If yes, what were your findings/observations?
3. You indicated that your agency is currently outsourcing most of its TMS activities even though your agency possesses the necessary technical capabilities to manage TMS activities in-house. (Follow-up to A10)
 - a. Can you give some insight about the reasons why your agency decided to outsource TMS activities?
 - b. If you have experience with both in- and outsourcing, do you believe outsourcing TMS activities improves quality, lowers quality, or is about the same when compared to insourcing?
 - c. Are there any barriers that prevent your TMS activities from being completed in-house?
 - d. Please define the barriers that you already identified. Did you ever take actions to overcome the identified barriers? What were those actions?
4. Your agency temporarily suspends data collection activities during certain months or periods. (Follow-up to A7)
 - a. Which types of data collection activities are suspended?
 - b. What is the duration of the temporary suspension for each type of activity?
 - c. How long has this process been in place and what was the rationale behind it?
 - d. What are the benefits of the temporary suspension?
5. Your agency relies on on-site consultants for data collection or processing. (Follow-Up to C4)
 - a. Can you describe your agency's experience with the process?
 - b. Do you see having the on-site consultants for data collection and processing beneficial to your agency?

Decision-Making Processes

6. Your agency has a defined process for decisions regarding [outsourcing/insourcing] of the TMS activities. (Follow-up to 11 and C1}. *If the agency responded indicating that they do not have a*

Assessment of In/Outsourcing Practices for TMS Category 2 Activities (Portable/Permanent Counts)

Interview Questions

documented process, we will ask them the reason(s) of not having one and if they see any challenges by not having a documented process.

- a. Can you briefly describe this process?
- b. Is it formalized? Is the process documented?
- c. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties.)
- d. Does this process work well for your agency?
- e. How could it be improved?
- f. How long has your agency been using this procedure?
- g. Has it undergone any recent changes? If so, why?
- h. How does your agency evaluate the advantages/disadvantages of outsourcing versus insourcing?
- i. In a perfect world, how would this process be handled?
- j. Who makes the final decision in this process?
- k. How often, or what, would cause this decision to be reevaluated?
- l. What would you change in the current process to make improvements?

Quality Assurance/Quality Control (QA/QC)

7. Your agency keeps track of the reliability measures of continuous count stations (CCS). (Follow-up to A6)
 - a. Can you briefly describe this process?
 - b. What do the reliability measures cover (speed, volume, classification)?
 - c. How detailed are the measures (e.g., is the lane-by-lane percentage of availability recorded in an automated system)?
 - d. How is reliability measured? Is the system comparing the data to the historical data of the same detector zone or lane readings, or is the data compared to upstream and downstream detector data with an algorithm that balances the volume between the detectors?
 - e. What were/are the challenges with developing/tracking these measures?
 - f. What are the benefits of having reliability measures?
 - g. What would you change in the current process to make improvements?
8. Your agency has a policy to inspect consultant equipment, installation, and data processing facilities/equipment on the site or in the field. (Follow-up to B7)
 - a. Can you briefly describe this process?
 - b. What are the most common types of field inspections?
 - c. Are the inspection procedures documented in the individual contracts or does the agency have documented regulations for such inspections?
 - d. What is the target number of inspections? How was that number determined? Do you achieve the target on an annual basis?
 - e. What are the challenges associated with the inspection process?
 - f. What are the benefits of the process?
 - g. What would you change in the current equipment inspection process to make improvements?
9. Does your agency have a warranty policy for installation of the CCS and associated traffic monitoring equipment/sensors? (Follow-up to E4)

Assessment of In/Outsourcing Practices for TMS Category 2 Activities (Portable/Permanent Counts)

Interview Questions

- a. If yes, how many years does the warranty typically cover?
 - b. Do you see it beneficial to have a warranty policy and what are the benefits of having a warranty policy in place?
10. Does your agency have a policy to reimburse consultants for material purchased for counts requiring pneumatic tubes, clamps, securing devices, etc.?
- a. If yes, what is the typical method for reimbursement?
 - b. Is the cost of materials included in the contracts with the consultants or is the cost treated as an extra cost item in addition to the contract value?
11. Does your agency have documented requirements/processes for QA/QC for your TMS activities?
- a. Can you briefly describe those requirements/processes?
 - b. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties)
 - c. Do you see it beneficial to have a documented QA/QC policy? If yes, what are the benefits?
 - d. What would you change in the current QA/QC process to improve it or make it more effective/efficient?

Proposed Processes

The objective of the 'Proposed Processes' section is to gather information that will be used in development of processes/matrices as part of the research recommendations, and the agencies that provided substantial input for this section will be asked to be contacted once more after the recommendations are drafted.

This section of the interview will involve open discussions regarding specific agency experiences associated with the processes based on the resourcing type of the agency, lessons learned from past programs/practices, etc., and focus on gathering feedback/input for potential processes that the research team has in mind. Examples include suggestions for process improvement measures, a decision-making process that could work for your agency (proposed but has not been implemented due a specific reason), or a process that you tried and refined after many iterations.

Assessment of In/Outsourcing Practices for TMS Category 3 Activities (Other/Innovative Contracting Methods)

Interview Questions

Category 3 - Other Contracting Methods

- Paying for quality data for a given time period (contractor obtained and quality controlled)
- Buying data from other sources such as GPS or probe-based data (e.g., INRIX™), or data collected by vendors using video detection (e.g., MioVision™)
- Equipment sharing techniques and agreements with other agencies
- Coordination of non-traditional sources to obtain counts such as data exchange/sharing agreements with other organizations or agencies (e.g., municipality, MPO, county, or private sector), or interdepartmental agreements such as traffic data collected by ITS devices
- Integration of the TMS data into the agency's or regional Archived Data User Service (ADUS)
- Management and quality control of data feeds into regional transportation data portals/archives (e.g., RITIS®, iPeMS®, DriveNet™)
- Publication of annual TMS reports, traffic volume maps, trends, data tables/graphs, and GIS shape files

Organizational Practices

1. You indicated that your agency in/outsources data collection activities.

a. How many years have you been in/outsourcing the data collection activities?

Data Purchase Agreements (paying for specific quality data or buying bulk data from vendors)

b. Why did you decide to procure data purchase from vendors/third parties?

c. What are the benefits of purchasing data from vendors/third parties?

d. What are the challenges of purchasing data from vendors/third parties? How do you overcome those challenges?

e. How do you control the data quality?

Data Exchange Agreements

f. Who is in your pool for data exchange agreements? Do you exchange data with agencies located outside of your state?

g. Why did you decide to establish data exchange agreements?

h. What are the benefits of data exchange agreements?

i. What are the challenges of data exchange agreements? How do you overcome those challenges?

j. How do you control the data quality?

Equipment and Resource Sharing Agreements

k. Who is in your pool for equipment and resource sharing agreements? Do you share resources with agencies located outside of your state?

l. Why did you decide to establish equipment and resource sharing agreements?

m. What are the benefits of equipment and resource sharing agreements?

n. What are the challenges of equipment and resource sharing agreements? How do you overcome those challenges?

o. How do you control the data quality?

Interdepartmental Agreements such as Traffic Data collected by ITS Devices

p. Do you have such practices/agreements? Reason?

q. What are the benefits of obtaining traffic data collected by ITS devices?

Assessment of In/Outsourcing Practices for TMS Category 3 Activities (Other/Innovative Contracting Methods)

Interview Questions

- r. What are the challenges of obtaining ***traffic data collected by ITS devices***? How do you overcome those challenges?
- s. Is the ITS-collected data used as primary or supplemental data?
- t. How do you control the data quality?

Data Feeds into Regional Transportation Data Portals/Archives (e.g., RITIS®, iPeMS®, DriveNet™)

- u. Do you feed data into regional archives/portals? Reason?
- v. What are the benefits of ***insourcing/outsourcing of data feeding***?
- w. What are the challenges of ***insourcing/outsourcing of data feeding***? How do you overcome those challenges?

Publication of Annual TMS Reports, Traffic Volume Maps, and GIS shape files

- x. How do you handle reporting, graphics, maps associated with traffic data (insourced or outsourced)? Any on-site consultants assisting you with such tasks?
- y. Any benefits or challenges associated with in- or outsourcing the data reporting?

General Assessment of Traffic Data Collection

- z. Do you have documented procedures for data processing (i.e., formatting, imputing, and extrapolating)?
 - aa. Did you ever compare the data quality for the periods when the process was in- or outsourced (i.e., before-after comparison)? If yes, what were your findings/observations?
2. Does your agency possess the necessary technical capabilities to manage TMS activities in-house? (Follow-up to A10)
- a. If you have experience with both in- and outsourcing, do you believe outsourcing TMS activities improves quality, lowers quality, or is about the same when compared to insourcing?
 - b. Are there any barriers that prevent your TMS activities from being completed in-house?
 - c. Please define the barriers that you already identified. Did you ever take actions to overcome the identified barriers? What were those actions?
3. Does your agency rely on on-site consultants for data collection or processing? (Follow-Up to C4)
- a. Can you describe your agency's experience with the process?
 - b. Do you see having the on-site consultants for data collection and processing beneficial to your agency?

Decision-Making Processes

4. Does your agency have a defined process for decisions regarding [outsourcing/insourcing] of the TMS activities. (Follow-up to 11 and C1)
- a. Can you briefly describe this process or the reason why you do not have a process in place?
 - b. Is it formalized? Is the process documented?
 - c. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties.)
 - d. Does this process work well for your agency?
 - e. How could it be improved?
 - f. How long has your agency been using this procedure?
 - g. Has it undergone any recent changes? If so, why?
 - h. How does your agency evaluate the advantages/disadvantages of outsourcing versus insourcing?

Assessment of In/Outsourcing Practices for TMS Category 3 Activities (Other/Innovative Contracting Methods)

Interview Questions

- i. In a perfect world, how would this process be handled?
- j. Who makes the final decision in this process?
- k. How often, or what, would cause this decision to be reevaluated?
- l. What would you change in the current process to make improvements?

Quality Assurance/Quality Control (QA/QC)

5. Does your agency have a warranty policy for data services and quality of data? (Follow-up to E4)
 - a. If yes, how many years does the warranty typically cover?
 - b. Do you see it beneficial to have a warranty policy and what are the benefits of having a warranty policy in place?
6. Does your agency have documented requirements/processes for QA/QC for your TMS activities?
 - a. Can you briefly describe those requirements/processes?
 - b. Can you provide us with the documentation? (Note that the documents will not be shared with other agencies or third parties)
 - c. Do you see it beneficial to have a documented QA/QC policy? If yes, what are the benefits?
 - d. What would you change in the current QA/QC process to improve it or make it more effective/efficient?

Proposed Processes

The objective of the "Proposed Processes" section is to gather information that will be used in development of processes/matrices as part of the research recommendations, and the agencies that provided substantial input for this section will be asked to be contacted once more after the recommendations are drafted.

This section of the interview will involve open discussions regarding specific agency experiences associated with the processes based on the resourcing type of the agency, lessons learned from past programs/practices, etc., and focus on gathering feedback/input for potential processes that the research team has in mind. Examples include suggestions for process improvement measures, a decision-making process that could work for your agency (proposed but has not been implemented due a specific reason), or a process that you tried and refined after many iterations.

**APPENDIX H – PENNSYLVANIA DEPARTMENT OF
TRANSPORTATION (PENNDOT) COST ANALYSIS
WORKSHEET**

Full Time Staff

Count Season starts March 1 (weather depending) and runs until November 20

107 Count days per season.

Factor 10 business days for weather

97 count days per season

38 weeks for Actual Counting

7 sites per day

97 days X 7 sites per day = 679 counts per person

50% of counts are machine classification $679 \times 50\% = 340$

Each class count equals 2 volume counts $340/2 = 170$

679 volume + 170 counts = 849 counts per person need to be completed (this number is needed for supply purposes)

$6600 \text{ counts} / 849 \text{ counts per person} = 7.7738 \text{ persons}$

Traffic Counters:

Each person would need 42counters each. To be able to set 21 counts a week by setting Monday, Tuesday, and Wednesday.

1 counter: \$700

42 counters X \$700 ea = \$29,400 for counters X 8 people = **\$235,200 for traffic counters**

Road Tube:

Each machine volume count uses 1 50 ft piece of road tube, 1 clamp, and 1 nail. A road tube can be used an average of 5 times.

$\$0.64/\text{foot} \times 50 \text{ foot} =$ \$32.00

1 clamp = \$1.00

1 nail (for end) = \$0.25

\$33.25 per 1 50 Ft Tube

849 sets/ 5 uses = 170 sets

170 sets X 33.25 per set = \$5,652.50 per person

$\$5,652.50 \times 8 \text{ people} =$ **\$45,220.00 for road tube**

Nails:

\$0.25 per nail

5 nails per set X 849 sets = 4,245 nails per person

4,245 nails X \$0.25= \$1,061.25

\$1,050 X 8 people= \$8,490.00

Road Tube Webbing:

1 roll of Webbing = \$22.50/150 ft

4 6 inch pieces are needed for each set = 2 ft per site

1 roll of Webbing = 75 sites

849 sites / 75 sites = 11.32 rolls of webbing (round to 12)

12 rolls webbing needed for each person

12 X \$22.50/roll= \$270.00 per person

\$247.50 X 8 people= \$2,160 for webbing

Road Tape:

1 roll of Road Tape= \$36.00/150 ft

8, 6 inch pieces are needed for each set = 4 ft per set

4 ft/ 150 ft (1 roll) = 37.5 sets

849 sets / 37.5= 22.64 rolls (round to 23)

23 rolls X \$36.00 per roll = \$828.00 per person

\$828.00 X 8 people = \$6,624.00

Hard Hat:

\$15.84 ea X 8 = **\$126.72**

Safety Vest:

\$39.74 ea X 8 = **\$317.92**

Amber Safety Light:

\$81.09 X 8 = **\$648.72**

Sledge Hammer:

\$30.60 ea X 8 = **\$244.80**

Crow Bar:

\$20.64 ea X 8 = **\$165.12**

Knee Pads:

\$21.69 X 8 = **\$173.52**

Gloves:

\$2.13 ea X 8 = **\$17.04**

Safety Goggles:

\$3.01 ea X 8 = **\$24.08**

Utility Knives:

\$2.55 X 8= **\$20.40**

Replacement Blades:

\$1.54 (10 per pack) X 4 = \$6.16 X 8 = **\$49.28**

100' Tape Measure:

\$ 8.71 X 8= **\$69.68**

Chalk Crayons:

\$ 16.03 per box (12 per box)

First Aid Kit:

\$18.13 X 8 = **\$145.04**

Insect Repellant:

\$8.97 X 8 = **\$71.76**

Phillpshead Screwdriver:

\$3.22 X 8 = **\$25.76**

Slotted Screwdriver:

\$3.46 X 8 = **\$27.68**

Electrical Tape:

\$1.04 X 8 = **\$8.32**

Locks: (one for each counter)

\$17.38 X 42 = **\$729.96**

Chains: (one for each counter)

\$41.90 X 42 = **\$1,759.00**

T-Shirts: (5 per person)

\$15.44 X 5 = \$ 77.20 X 8 = **\$617.60**

Rain Coat:

\$6.82 X 8 = **\$54.56**

Cell Phone Monthly Plan:

\$41.21 per month X 9 months = 370.89 X 8 = **\$2,967.12 for cell phone plan**

Cell Phone Car Charger:

\$29.99 X 8 = **\$239.92**

Travel Expenses:

Hotel: 4 nights X \$75.00 per night = 300.00 per week X 38 weeks = \$11,400 per week X 8 people
\$3,900 per week X 8 people (excludes District 5 and 8)= **\$91,200 for hotels**

Overnight Subsistence:

\$41.00 per day X 4 days = \$164.00 X 38 weeks = \$6,232.00 X 8 people = **\$49,856.00**

Salary:

\$17.38 per hour X 7.5 hrs a day: \$ 130.35 per day X 190 days = \$24,766.50 per person X 8 people = **\$198,132.00**

***Mileage:**

200 miles a day X 4 count days = 800 miles X 0.78 per mile = \$624.00 per week X 38 count weeks = \$23,712.00 X 8 people = **\$189,696.00**

In addition to daily miles there is the mileage to get to each district. BPR central office used as headquarters. Each District Office used as the end point.

District 1-0	217 miles	X 2 for round trip	434 X 0.78	\$338.52
District 2-0	132 miles	X 2 for round trip	264 X 0.78	\$205.92
District 3-0	90 miles	X 2 for round trip	180 X 0.78	\$140.40
District 4-0	125 miles	X 2 for round trip	250 X 0.78	\$195.00
District 5-0	84 miles	X 2 for round trip	168 X 0.78	\$131.04
District 6-0	91 miles	X 2 for round trip	182 X 0.78	\$141.96
District 8-0	2 miles	X 2 for round trip	4 X 0.78	\$3.12
District 9-0	133 miles	X 2 for round trip	266 X 0.78	\$207.48
District 10-0	177 miles	X 2 for round trip	354 X 0.78	\$276.12
District 11-0	212 miles	X 2 for round trip	424 X 0.78	\$330.72
District 12-0	182 miles	X 2 for round trip	364 X 0.78	\$283.92

*Based on information provided by the equipment division for station wagons/mini-vans.

** It would cost **\$884,954.03** to collect the 6600 counts needed and require a minimum of 8 people.

The price per count would be \$134.08 which is \$45.98 more than what it will cost with the vendor contract.

Additional costs not included in the \$884,954.03:

Overhead/Oversight Costs:

1 FTE Pay Range 8 Annual Salary = **\$65,500** (includes benefits)

2 FTE Pay Range 6 as a lead worker main contact during count season

Annual Salary (includes benefits) = **\$53,900.00 X 2 = 107,800**

Current Traffic Equipment Shop is not adequate to handle all of the equipment listed above.

Current Traffic Shop Monthly Rent: **\$2,769.38**

Voyager Card Charges = UNKNOWN

Vehicles from Fleet = UNKNOWN