

North American Study on Contracting Snow and Ice Response

Western Transportation Institute

The logo for CLEAR ROADS is contained within a black rectangular border. The word "CLEAR" is in white, bold, sans-serif font on a black background. The word "ROADS" is in black, bold, sans-serif font on a white background. A stylized black road shape curves from the bottom of "ROADS" towards the right.

CLEAR ROADS

research for winter highway maintenance

Project 99006/CR15-03
January 2017

Pooled Fund #TPF-5(218)
www.clearroads.org

This page intentionally left blank

North American Study on Contracting Snow and Ice Response

Final Report

Prepared by:

Laura Fay
Anburaj Muthumani
Western Transportation Institute
Montana State University

Dave Bergner
Monte Vista Associates, LLC

Jason Bittner
Applied Research Associates, Inc.

January 2017

Published by:

Minnesota Department of Transportation
Research Services & Library
395 John Ireland Boulevard, MS 330
St. Paul, Minnesota 55155-1899

This report represents the results of research conducted by the authors and does not necessarily represent the views or policies of the Minnesota Department of Transportation and/or WTI/MSU. This report does not contain a standard or specified technique.

The authors and the Minnesota Department of Transportation and/or WTI/MSU do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to this report.

Technical Report Documentation Page

1. Report No. CR15-03	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle North American Study on Contracting Snow and Ice Response		4. Report Date January 2017	
		5. Performing Organization Code	
7. Authors Laura Fay, Anburaj Muthumani, Dave Bergner, Jason Bittner		8. Performing Organization Report # CR15-03	
9. Performing Organization Name & Address Western Transportation Institute Montana State University PO Box 174250 Bozeman, MT 59717		10. Purchase Order No.	
		11. Contract or Grant No. MnDOT No. 99006, WO 11	
12. Sponsoring Agency Name & Address Clear Roads Pooled Fund Minnesota Department of Transportation 395 John Ireland Blvd St. Paul, MN 55155-1899		13. Type of Report & Period Covered Final Report [Nov. 2015 – Jan. 2017]	
		14. Sponsoring Agency Code	
15. Supplementary Notes Project completed for Clear Roads Pooled Fund program, TPF-5(218). See www.clearroads.org .			
16. Abstract <p>Snow and ice control operations are a vital function often conducted by state and local transportation agencies. Many states are choosing to contract snow and ice response services, instead of or in addition to the use of in-house forces, to maintain lean departments and avoid the equipment responsibilities. This has been a common practice for years, at both state and local levels. How, when, and why contractors are used varies considerably among agencies.</p> <p>Traditionally, contractors have been used for temporary acute shortages of trucks and personnel or for extreme weather situations that taxed agency capabilities, or agencies have used contractors for snow routes in remote locations. Contractors augment agency staff by regularly handling assigned routes throughout a specific winter season; supplementing agency staff on an as-needed, where-needed basis in case of a shortage of agency personnel and/or equipment; and handling all snow and ice control in a defined area as part of a long-term asset management contract that includes other roadway maintenance activities.</p> <p>Contracting winter maintenance services has been a key operational strategy for many state, local, and provincial road agencies, but little work has been done to clearly define the extent of the use of contracted services, specifically in snow and ice control operations, or to summarize the effective practices. To address this issue, this research effort utilized a literature review, survey, and synthesis of collected information to identify the state-of-the-practice and state-of-the-art when using contracted services, and identifies lessons learned by agencies. The report presents conclusions and recommendations based on the research effort.</p>			
17. Key Words Snow and ice control, winter maintenance, contracting		18. Distribution Statement No restriction. This document is available to the public through the Clear Roads pooled fund project and the Minnesota Department of Transportation.	
19. Security Classification (this report) Unclassified	20. Security Classification (this page) Unclassified	20. No. of pages 40	21. Price -0-

ACKNOWLEDGMENTS

We would like to acknowledge the following Clear Roads project panel members for their role in this project: Justin Droste, Paul Brown, Caleb Dobbins, Jonathan Fleming, Joe Bucci, Allen Williams, Mike Lashment, and Frank Sharpe. Additionally we would like to acknowledge Greg Waidley of CTC & Associates for his role coordinating the project. We would like to thank the individuals and organizations that took the time to participate in the survey for this project, and the WTI support staff Dana May and Carla Little for their role as technical editors.

TABLE OF CONTENTS

Chapter 1: Introduction	1
1.1 Background	1
1.2 Methodology	3
1.2.1 Literature Review.....	3
1.2.2 Survey	3
1.2.3 Summary of Findings.....	3
Chapter 2: Literature Review	4
2.1 Reasons for Agencies to Seek Contractors	4
2.1.1 Lack of resources	4
2.1.2 Seasonal Variations in Maintenance Workloads	5
2.1.3 A state-level movement toward outsourcing or privatization.....	5
2.1.4 Cost comparisons	5
2.1.5 Other factors for using Contracted Services	6
2.2 Types of Contracting Methods and Duration of Contracting	6
2.3 Performance Based Maintenance Contracts (PBMC).....	8
2.4 Equipment and Materials	9
2.5 Contracting Provisions Regarding Equipment Specifications	11
2.6 Training.....	11
2.7 Monitoring and Supervision	12
2.8 Importance of Geographic Area (Rural VS Urban) in Contracting.....	12
2.9 Benefits of Contracting.....	12
2.10 Concerns about Outsourcing.....	13
2.11 Cost, Performance, and Level of Service Comparison Between In-house and Contractors	14

2.12 Quality Control Measures and Performance Indicators Used by Agencies.....	15
2.13 Review, Revision and Termination of Snow and Ice Response Contracts.....	16
Chapter 3: Survey Summary.....	18
3.1 Background Information.....	18
3.2 Reasons and Type of Contracting.....	18
3.3 Qualifications and Training	19
3.4 Geographic Location.....	19
3.5 Equipment and Snow and Ice Control Materials	20
3.6 Cost, Performance, and Level of Service.....	20
3.7 Emergency Deployments	21
3.8 Safety	22
3.9 Issues with Contracted Services.....	22
Chapter 4: Summary of Findings.....	24
4.1 State DOT Contracting Practices	24
4.1.1 Common Practices	24
4.1.2 Effective Practices	25
4.1.3 Motivations for Not Contracting Snow and Ice Response.....	25
4.1.4 Lessons Learned.....	26
4.2 State DOT Procurement Methods for Contracting	27
4.2.1 Contracted Services	27
4.2.2 Type of Contracts.....	27
4.2.3 Duration of Contracts.....	28
4.2.4 Qualification and Training.....	29
4.2.5 Equipment and Snow and Ice Control Materials	30
4.3 Cost Comparison.....	32

4.4 Safety Issues and Experiences	32
4.5 Emergency Management	33
4.6 Incentives and Disincentives in Contracting.....	34
Chapter 5: Conclusions and Recommendations	37
Appendix A: Survey Questionnaire.....	A1
Appendix B: Detailed Survey Responses.....	B1
Appendix C: Final Report Presentation.....	C1

LIST OF FIGURES

Figure 1: States that responded to the survey	B2
---	----

LIST OF TABLES

Table 1: Number of responses for each group	B1
Table 2: Agencies responses for agency use of contracted services for snow and ice control operations.....	B3
Table 3: Primary reasons for the agency to use contracted services for snow and ice control operations.....	B4
Table 4: Contracting methods used by the agency for snow and ice control operations.....	B6
Table 5: Agencies method to establish contracts for snow and ice control operations	B7
Table 6: Agencies requirement for any additional training for contractors’ personnel after the contract is awarded	B10
Table 7: Contract provision for delivering snow and ice control materials (salt, sand, liquid chemicals, etc.).....	B15
Table 8: Performance Based Contracting Method for snow and ice control operations	B16
Table 9: Monitoring of contractor’s Material Application Rates	B18
Table 10: Performance standards for contracting services	B18
Table 11: Quality control measures for contracting services.....	B19

Table 12: LOS comparison between in-house and contracted services.....	B21
Table 13: Cost comparison between in-house and contracted services	B22
Table 14: Contracts during emergency deployments.....	B24
Table 15: Agencies action during emergency deployments	B24
Table 16: Agencies action during emergency deployments	B26
Table 17. Agencies that have reverted from using contracted forces back to in-house forces...	B28

EXECUTIVE SUMMARY

Snow and ice control operations are a vital function often conducted by state and local transportation agencies, including tribal, municipal, and county public works departments (DPWs). Winter weather, including snow and ice storms, can severely affect safety and mobility on highways and local roads, causing billions of dollars in lost productivity and commerce (Soergel, 2016), damage to vehicles and property, and thousands of injuries and fatalities (FHWA, 2016).

In recent years, the pattern of winter storms has become more extreme and regions of the U.S. that typically had little or no snow and ice have experienced unusually severe seasons. Even in the traditional “snow belt,” winter storms seem to have become more frequent and/or more intense. Regardless of whether a winter storm produces an inch or a foot of snow, DOTs and DPWs must still provide measures to keep the roadways open. This has always been a challenge but even more so as agency workforces have been reduced by stagnant or decreasing budgets resulting in a decreased number of permanent staff positions and equipment. For many agencies, the remaining equipment is aging and thus maintenance and repair costs are increasing. In addition, a large percentage of agency personnel will be eligible to retire in the next five years, and agencies report difficulty in recruitment and retention of new employees.

At the same time, growth and development continue in most areas, adding lane-miles and increasing traffic volumes. Simply stated, service demand exceeds agency resources. Many agencies have addressed this shortfall through changes in material usage, revising Levels of Service (LOS) guidelines, extending routes and work-hours, using employees from other departments and divisions who traditionally have not been a part of the “snow force,” and utilizing equipment from other departments such as dump trucks, pickups, and even refuse trucks. Many states are choosing to contract snow and ice response services to achieve lean departments and avoid the burden of personnel and equipment responsibilities. Though this has been a common practice for years, at both state and local levels, the degree of use of contractors varies considerably among agencies. For example, Wisconsin DOT contracts with each county to handle snow and ice control on state highways. Other states, such as Missouri, Virginia, and Canadian Provinces, reduced or eliminated agency maintenance personnel and rely mostly or entirely on contractors or seasonal employees. In each of these scenarios contractors are required to have sufficient equipment and operators comparable to agency resources to satisfactorily manage the “typical” range of storms for the specific locale. In other words, the contractor must be able to meet LOS standards for assignments the same, or better than, in-house staff.

Traditionally, contractors have been used for temporary acute shortages of trucks and personnel, for extreme weather situations that taxed agency capabilities, or agencies have used contractors for snow routes in remote locations. Contractors augment agency staff by regularly handling assigned routes throughout a specific winter season; supplementing agency staff on an as-needed, where-needed basis in case of a shortage of agency personnel and/or equipment; and handling all snow and ice control in a defined area as part of a long-term asset management contract that includes other roadway maintenance activities. In the context of this project maintenance contractors may be private companies or local agency/municipality staff and equipment.

Contracting winter maintenance services emerges as a key operational strategy for many state, local, and provincial road agencies, but little work has been done to clearly define the extent of the use of contracted services, specifically in snow and ice control operations, or to summarize the effective practices. To address these issues, this research effort utilized a literature review, survey, and synthesis of collected information to identify the state-of-the-practice and state-of-the-art when using contracted services, and identifies lessons learned by agencies.

Much of the available information on contracted services is provided in the context of general maintenance, and only rarely specifically addresses contracted services for winter maintenance operations. The main reasons for agencies to seek contractors for snow and ice response include:

- lack of resources,
- a state-level movement toward outsourcing or privatization, and
- cost comparisons.

In general, winter maintenance agencies use four types of contracting methods for snow and ice response:

- rental agreements or short-term contracts,
- defined amount of work or recurring work contracts,
- blended forces, and
- asset management and public-private partnership contracts.

Performance-Based Maintenance Contracts (PBMC) are increasingly popular in the United States and Canada. In PBMC, winter maintenance agencies usually set a minimum Level of Service (LOS) and response time to measure the performance.

In most cases, winter maintenance agencies tend to rely on contractors to provide their own snow and ice equipment. Conversely, snow and ice control materials (salt, sand, etc.) are commonly provided by the agencies.

Studies have shown the need for minimum standards for the equipment used by contractors, such as replacement time of aging equipment and upgrading to new technologies.

It is generally perceived that urbanized areas, which have a higher density of contracting firms, are a more favorable environment to use contractors for snow and ice control functions. However, contractors are willing to work in remote areas if the size and duration of contracts are large enough.

Without definitive conclusions, it is generally perceived that contracting potentially reduces the cost for highway maintenance operations. However, the benefits of using in-house versus contracted services may be more qualitative than quantitative.

Evidence of contracting resulting in improved LOS is inconclusive. Studies reported that contractors either have improved LOS compared to in-house or provide the same LOS as in-house. However, there is a high chance of decreased performance in the first few years of contracting.

Winter maintenance agencies have quality control measures to ensure that contractors are providing the best possible LOS for the public. This has been achieved through well-defined goals and objectives for contractors. In some cases, winter maintenance agencies either penalized the contractors, terminated the contractors, or reverted to in-house service if poor performance by contractors occurred.

Incentives and disincentives appear to be commonly used with contracted snow and ice response. Some transportation agencies have had positive results from the use of incentive programs, and have been able to use this to eliminate poorly performing contractors with disincentive programs.

The following recommendations were made as a result of the synthesis of this information.

- When contracting for snow and ice response, contract language should address the responsibility of equipment calibration, how often equipment should be calibrated, and who is responsible for the calibration. This is one area where large improvements could be achieved in accuracy of applications.
- To ensure the highest level of snow and ice response, the contracting agency should consider including minimum pre-qualifications to qualify for a contract, and annual training for contracted staff.
- Available cost data related to use of contracted services for snow and ice response is inconclusive, therefore we recommend cost data be collected and compared between the use of in-house services and contractors. There is a need to compare costs on even terms, specifically similar LOS expectations.
- There appears to be a lack of available data on safety and performance of contracted snow and ice response as compared to the use of in-house resources, therefore we recommend conducting a safety study to compare crashes and accident rates between in-house and contracted service staff.
- It is recommended that agencies that use contracted services for snow and ice response consider requiring all contracts comply with FEMA guidelines in the event these services are necessary in an emergency situation.

CHAPTER 1: INTRODUCTION

1.1 Background

Snow and ice control, also referred to as winter roadway maintenance operations, is a vital function of state transportation agencies and tribal, municipal and county public works departments (DPWs). Snow and ice storms can severely affect safety and mobility on highways, roads, and streets causing billions of dollars in lost productivity and commerce, damage to vehicles and property, and thousands of injuries and fatalities. Poor road conditions due to these storms disrupt normal life for millions of people, whether commuting to work and school, shopping, or traveling to appointments and important personal and community events. Snow and ice also hampers the ability of emergency service providers to quickly respond to critical incidents.

In recent years, many extreme winter storms captured headlines and regions of the U.S. that typically had little or no snow and ice have experienced several severe seasons. Even in the traditional “snow belt,” winter storms seem to have become more frequent and/or more intense (NOAA 2016). Regardless of whether a winter storm produces an inch or a foot of snow, DOTs and DPWs must still provide measures to keep the roadways open. This has always been a challenge but even more so as the workforces of these agencies have been pummeled by drastic budget reductions resulting in permanent loss of positions and equipment. What equipment remains is aging and thus maintenance and repair costs are increasing. In addition, many agency personnel will be eligible to retire in the next five years, and agencies report difficulty in recruitment and retention of new employees.

At the same time, growth and development continue in most areas, adding lane-miles and increasing traffic volumes. Simply stated, service demand exceeds agency resources. Many agencies have addressed the shortfall through changes in material usage, revising Levels of Service (LOS) guidelines, extending routes and work-hours, using employees from other departments and divisions who traditionally have not been a part of the “snow force,” and utilizing equipment from other departments such as dump trucks, pickups, and even trash packers. Many states are choosing to contract these services to maintain lean departments and avoid the equipment responsibilities. This has been a common practice for years, at both state and local levels. How, when, and why contractors are used varies considerably among agencies. In the context of this project maintenance contractors may be private companies or local agency/municipality staff and equipment. For example, Wisconsin DOT contracts with each county to handle snow and ice control on state highways. Some other states, such as Missouri and Virginia, reduced or eliminated agency maintenance personnel and rely mostly or entirely on contractors or seasonal employees. Using contractors when there was a temporary acute shortage of trucks and personnel, or for extreme weather situations that taxed agency force capability, has been the norm for decades. In addition, states have also used contractors for snow routes in remote locations.

Contracting winter maintenance services has been a key operational strategy for many state and local road agencies, but little work has been done to clearly define the extent of the use of contract services in winter operations and to summarize the-state-of-the-practice.

Numerous issues must be addressed in order to provide timely, reliable and cost-efficient contracted services for the public, including:

- Criteria for minimum qualifications of contractor,
- Legal status to transact business,
- Performance history and experience,
- Financial resources to provide continuity of business between actual employment,
- Provision of sufficient insurability, bonding, and indemnification,
- Vehicles: number, type, condition, availability of units, reserve capacity,
- Equipment required on vehicles (plows, spreaders, liquid applicators, lighting, communications),
- Calibration of spreaders and applicators,
- Personnel: number, driving records, training, licensing, availability, and back-ups,
- Supervisory and management staff including dispatching,
- Facilities including materials storage, fueling, and maintenance,
- Sub-contracting or substitutions, allowed or prohibited,
- Performance measures and standards equal to that required of agency force,
- Notification process and maximum time to report to station,
- Reporting and tracking of work-in-progress (AVL, radio, phone; who provides system?),
- Length of contract period (seasonal, annual, multi-year),
- Method of compensation (per storm, per lane-mile/km, per hour, etc.); minimum guarantees,
- Manner of payment, and
- Penalties, withholding, disqualifications, resolution of disputes related to performance.

Additional questions for consideration include:

- Should contractors be pre-qualified and how is that determined?
- When and how will contractors be used: regularly for each event or only for over-load situations? What about for emergencies outside of assigned area?
- How many contract trucks or personnel or both are needed and what is the basis for that determination?
- What is the funding source and budgeted amount for contracting?
- Do contractors supply material they use or does that come from agency stockpiles? If the latter, how is that accounted for and what happens to unused material at the end of each storm or season?
- In case of contractor equipment breakdowns, can/will agency staff repair or provide facility, parts?
- For vehicle collisions and property damage caused by contractor, who is liable? Who investigates? How are accidents tracked- preventable versus not, for contracted versus in house services?
- Are there obstacles in the agency procurement and payment process and policy that hinder attracting contractors?

1.2 Methodology

1.2.1 Literature Review

For this task, available literature was synthesized to document the state-of-the-practice and the state-of-the-art pertinent to contracted services used for snow and ice response. In particular, the research team documented the state-of-the-practice that is focused on costs, benefits, practices, and complexities associated with contracting for snow and ice response. This was accomplished by conducting a review of several databases to gather relevant information, including: Transportation Research Information Service (TRIS), Google Scholar, ISI Web of Science, and Montana State University Library. International sources were reviewed, specifically research conducted in Canada wherever available, along with the ongoing research and existing documents published by the DOTs, Clear Roads, Pacific Northwest Snowfighters (PNS) Association, university transportation centers (UTCs), Strategic Highway Research Program (SHRP), FHWA, National Cooperative Highway Research Program (NCHRP), Airport Cooperative Research Program (ACRP), American Public Works Association (APWA), AASHTO, and information presented at the Winter Maintenance Peer Exchanges. It should be noted that most of the literature available for this task contained information about contracting on all highway infrastructure maintenance operations such as pothole repair, guardrail repair, etc. This report attempted to extract information related specifically to contracting for winter maintenance activities.

1.2.2 Survey

An online survey was conducted using the online survey tool Survey Monkey. The purpose of this survey was to gather information from winter maintenance agency supervisors and managers on their experience with contracting for snow and ice control operations. Respondents were asked 48 questions to gather information about contracting used for snow and ice response in North America. The full survey questionnaire can be found in Appendix A. The survey was distributed among Clear Roads member states, APWA, the Snow and Ice Listserv, and posted on the Winter Maintenance & Effects LinkedIn page. The survey was open for responses from May 16, 2016 – Jun 24, 2016 and received 51 responses representing 31 US states and three Canadian provinces.

1.2.3 Summary of Findings

For this task, the research team utilized information gained from the literature search and survey responses to analyze and document state DOT contracting practices and procurement practices, cost comparison information, benefits noted from adopting states, safety issues and experiences, emergency management, incentives, and general observations. The information is presented in a condensed, synthesized format.

CHAPTER 2: LITERATURE REVIEW

The literature review captures information on the state-of-the-practice and state-of-the-art when using contracted maintenance services. It also identifies lessons learned by agencies so this information is not lost. Please note that much of the information in the published domain on contracted services is provided in the context of routine general maintenance, and only rarely do these reports specifically address winter maintenance operations. To distinguish the source of the information, when information pertains specifically to winter maintenance operations this is stated in the text.

2.1 Reasons for Agencies to Seek Contractors

Contracting, sometimes referred to as Outsourcing and/or Privatization, became popular in the late 1980s and 1990s in the transportation sector. In particular, U.S. agencies that contracted highway services were usually seeking assistance with maintenance and operational activities. A study by AASHTO identified three potential motivations for contracting: 1) an agency shortage of needed resources, 2) a policy or political mandate to outsource, and 3) a credible cost-effectiveness of contracting (AASHTO, 2002). These three motivations are explored in the following sections.

2.1.1 Lack of resources

Traditionally, the primary reason for contracting highway maintenance and operational activities is a lack of in-house resources. In particular, reasons for contracting were most frequently related to either *increased workloads* or *decreased staffing levels*. For example, contracting services can supplement existing state resources when there are:

- caps on labor,
- limitations on the equipment fleet, or
- needs for additional attention for a particular highway segment.

A survey conducted for NCHRP Synthesis 313 found that *personnel constraints* and *lack of needed skills, equipment, or expertise* were the primary driving forces for government agencies to move towards privatization (Warne, 2003). In particular, growing demands for improved LOS during winter maintenance activities and limitations on available resources, such as vehicles and equipment fleet maintenance, led state DOTs to consider contracting these services. NCHRP scan tour found that Rhode Island and Virginia DOTs reported that the number of maintenance employees dropped by more than half (Duncan et al., 2014).

Transportation agencies that have a surplus of in-house equipment tend to use contracted employees to address significant variations in maintenance workloads (e.g., extreme storm events). Regular road maintenance activities are often variable because they are dependent on the weather. Significant variations in normal workloads for snow and ice response can occur due to needed night shift operations, heavy and/or unusual snow storms, and services to auxiliary roads.

2.1.2 Seasonal Variations in Maintenance Workloads

NCHRP scan tour found that seasonal variations in maintenance workloads play a significant role for seeking contractors. This is typical for transportation agencies that require additional staff in the winter for snow and ice control. However, these additional staff may not be needed during the summer months resulting in a waste of resources. In such instances, outsourcing additional staff may be required for winter maintenance activities only and then for summer months agencies may use a smaller group of core staff. As an example, the scan tour found that 90% of New Hampshire DOT outsourcing expenses are associated with winter maintenance operations (Duncan et al., 2014).

2.1.3 A state-level movement toward outsourcing or privatization

Another reason for contracting winter operations may be due to changes in laws that mandated certain functions be outsourced. This may be done as legislation or by executive order at the state level. As an example, Virginia DOT (VDOT) uses Turnkey Asset Maintenance Services (TAMS) contracts for providing highway maintenance operations in Virginia. TAMS contracts were created in 2006 as a part of the Acts for Assembly (Chapter 782), requiring all interstate maintenance to be outsourced by July 2009 (VDOT, 2008). TAMS contracts both summer and winter work including roadside maintenance, roadway repairs, incident management, snow removal, and emergency response. In support of this, a survey from NCHRP Synthesis 329 noted that a “highway agency manager referred to a general desire to shrink the role of government as a motivating force” (Markow, 2014). In such cases, reducing the number of state employees will result in an increased mandate to outsource (Warne, 2003). For instance, Florida DOT contracted 60% of its routine maintenance activities and reduced its employee level by 25% based on initiatives from the Governor of Florida (Ribreau, 2004). A survey from Stowe et al. (2007) found that a state highway agency started contracting maintenance operations based upon indications from the legislature that it was considering privatization or outsourcing. This information was gained through continual monitoring of legislative activities and discussions with legislative members and staff.

2.1.4 Cost comparisons

Cost comparisons, between using in-house versus contracted services, often plays a smaller role in a state agency’s decision to contract winter maintenance operations. In fact, NCHRP synthesis 313 found that studies that attempted to quantify cost-effectiveness were unable to provide definitive conclusions regarding the cost differences between in-house and contracting services (Warne, 2003). In 2001, Oklahoma DOT contracted (two five-year contracts) its routine maintenance operations including snow and ice control operations to resolve its state budget problems (Ribreau, 2004). In the early 1990s the Alberta Government was faced with growing deficits and debt, and therefore moved towards contracting maintenance services to reduce the overhead of maintaining in-house staff and equipment (Lali and Nick, 2005).

Despite the studies raising concerns about obtaining accurate data, both direct and indirect costs are needed to complete an effective cost comparison between in-house and contracted services. The benefits of using in-house versus contracted services may be more *qualitative than quantitative* (Warne, 2003), and cannot have a dollar value assigned to them. Duncan et al.

(2014) found that higher level of service was expected from a contractor compared to in-house services, and that this adds complexity to the cost calculation. Interestingly, the scan tour conducted for NCHRP scan tour was not able to obtain any documentation of cost savings due to the use of contracted services (Duncan et al., 2014). Despite the lack of definitive conclusions, agencies considered cost as a factor for privatization. In some cases, politically motivated contracts were driven by the claims of expected savings (Ribreau, 2004).

2.1.5 Other factors for using Contracted Services

In the survey for NCHRP Synthesis 329, several other factors were identified as reasons for the use of contractors. Factors included in the survey questionnaire were (Markow, 2014):

- Feeling that agency forces are already able to meet winter levels of service technologically and cost-effectively
- Difficulty in retaining & replacing skilled workers (e.g., due to skill specialization or local competition for skills)
- Aging employee workforce
- Desire to reduce financial burden of wages and overhead
- Employee union-related considerations (if applicable)
- Ready availability of options among qualified public or private winter service providers
- Competitiveness of local construction industry (i.e., availability of sufficient number of qualified bidders)
- Risks inherent in fulfilling winter M&O services satisfactorily (financial? performance? Other risks?)
- Capability of agency to manage new methods of delivering winter M&O
- Cost of transitioning agency to a new method of winter M&O delivery

Interestingly, survey respondents believe that agency forces are already able to meet winter levels of service technologically and cost-effectively, regardless of whether or not employees are the primary means of service delivery (Markow, 2014).

The NCHRP scan tour noted that *agencies should be reluctant to contract all winter maintenance activities that affect public safety*. Agencies are expected to provide remedial action if the contractor fails to provide the necessary maintenance (Duncan et al., 2014).

2.2 Types of Contracting Methods and Duration of Contracting

U.S. transportation agencies use contractors mainly for short-term contracts, including rental agreements, one to three year contracts, and agreements with other government agencies, such as municipalities, counties, and special authorities, for winter services. For example, WisDOT contracts its routine maintenance functions on state, federal, and interstate highway systems to the 72 county highway departments in the state (Duncan et al., 2014). However, in most cases, agencies use *contracting only during extraordinary circumstances*. NCHRP Synthesis 313 conducted a detailed survey to determine the type of contracting methods used in the U.S. From the survey responses, there are typically four types of contracting methods (Markow, 2014).

- Rental Agreements or Short-term Contracts

The first type involves the use of *rental agreements or short-term contracts* only in *extraordinary circumstances*, such as severe storms or to haul away excess snow that has been plowed to the side of the road. In addition, agencies supplement their full-time staff by hiring local individuals with their own equipment as temporary, or seasonal workers only for winter months. Other winter maintenance activities are entirely performed by the agency employees. The following states use this type of contracting: Alaska, California, Idaho, Iowa, Minnesota, Nevada, and North Dakota (Markow, 2014).

- Defined Amount of Work or Recurring Work Contracts

The second type of contracting involves a defined amount of work on a recurring basis, which include contracts with local governments (county or city), private individuals, or firms to provide snow and ice control on state routes. For example, Colorado has a longer-term contract to perform maintenance on 10-centerline miles of High-Occupancy Toll (HOT) lanes to the highest levels of service. However, other winter maintenance and operations work is performed by transportation agency staff. The following states use this type of contracting: Kansas, Maine, Montana, New York, South Dakota, and Vermont (Markow, 2014).

- Blended Forces

The third type of contracting services involves the use of both state forces and contractors for winter services, with contractors handling the majority of the effort statewide. Markow (2014) noted three reasons for such contracts: use of local labor forces (without formal contracts), past efforts at privatization, and budget constraints. Massachusetts and Michigan were identified as using this type of contracting.

- Asset Management and Public-Private Partnership Contracts

The fourth type involves the use of more comprehensive contract mechanisms for winter maintenance and operations services, including asset maintenance contracts and public-private partnerships (Markow, 2014).

In addition, NCHRP scan tour found another type of contract commonly used by various agencies for winter maintenance (Duncan et al., 2014).

- Cost-reimbursable contracts

In this type of contract, contractors are mostly local government agencies (municipalities and counties) who provide the required service and invoice the state for the cost for the maintenance. The contracting agency generally specifies the expected Level of Service and establishes how costs are calculated for each service (Duncan et al., 2014).

Though long-term contracts are not common in the U.S., Alberta Transportation and Utilities (AT&U) of Canada provides five year term contracts for its winter maintenance operations. The main reasoning behind the longer contract period is to provide contractors sufficient time to make a return on their initial capital investment (Lali and Nick, 2005). For example, Maine DOT

uses three year contracts for snow and ice control with an option for a three year extension (based on the success of existing contract). Contractors are thus more likely to make a return on their start-up investment expenses over a longer period of time (Duncan et al., 2014). Similarly, maintenance departments in Ontario, Canada provide five year contracts for maintenance operations. Sweden unbundles the snow and ice control contracts from the general maintenance cost with a negotiated cost with the government in the spring (Wilson, 1999).

2.3 Performance Based Maintenance Contracts (PBMC)

Performance-Based Maintenance Contracts (PBMC) provides incentives and/or disincentives to the contractor to achieve desired outcomes or results. As NCHRP synthesis 389 states “*The hallmark of PBMC is to pay a contractor based on the results achieved, not on the methods for performing the work*” (Hyman, 2009). In PBMC, contractors have more control over the methods used for maintenance and assume more of the risk to achieve specified level of service (AASHTO, 2002).

Early efforts using PBMC in other countries required contractors to hire government employees, lease or purchase equipment, and utilize maintenance yards. Contractors may hire retired state employees to perform the winter maintenance operations. This is due to the requirement of specialized skills to perform maintenance operations especially related to snow and ice control (Harrier and Randolph, 1997). The contractors’ performance was controlled by the establishment of performance “standards.” These outcome standards took the form of timeliness requirements for equipment repairs. Performance contracts have continued to evolve with additional specifications being added over time. Control mechanisms such as liquidated damages, incentive, and disincentive payments have provided the government with the controls needed to ensure minimum levels of service are met (Hyman, 2009).

There are substantial benefits to specifying performance driven outcomes. The traditional methods of contracting required a considerable effort to measure the quality of materials; to inspect quality of methods, equipment and personnel used by the contractor; and to measure work performed. Transportation agencies had to predict the quantities of work that needed to be performed over the contract period and pay for all work performed. All the risk was on the transportation agency and any additional work required to maintain the desirable level of service had to be paid for at the bid price (Halcrow, 2011).

In PBMC, the contractor takes full responsibility for ensuring that performance standards are met. PBMC are usually long-term agreements in which minimum performance levels are established and the contractor is given complete control of the work. Level of Service is widely used as a measure of performance. However, response time can also be used to measure performance especially when dealing with winter maintenance operations. PBMC has been used worldwide, including in the United States and Canada. States, provinces, and other entities that have been leaders in the use of PBMCs include: Virginia, Texas, Florida, the District of Columbia, British Columbia, Alberta, and Ontario (Hyman, 2009).

The NCHRP scan tour scan tour reported that creative use of incentive and disincentives can improve the performance of contracted services. However, the responsibility lies with the DOTs to modify the incentive and disincentives plan as they gain experience. For example, initially the

VDOT's disincentive plan was found to be too harsh on contractors resulting in adjustments (interesting, later it was considered to be not harsh enough). In general, the study suggests the penalties should be commensurate with the level of risk assumed by the contractor (Duncan et al., 2014).

However, several PBMC implementation challenges were identified by Hyman (2009) including:

- “Agencies differ in their management culture and the strength of traditional versus progressive attitudes toward change. Some agencies are more proactive in embracing new practices, while other are more cautious.
- Under a performance concept, owners must give up their tendency to control work and give direction. Some agencies, however, are uncomfortable in relinquishing control, particularly over key decisions in the means and methods of accomplishing work. Pakkala et al. (2007) noted that this problem is cultural, difficult to change, and ‘cannot be altered overnight.’ It can persist even if the contract wording has technically relinquished control over decision-making to the contractor.
- Agencies need to draft performance-based specifications carefully; they require time and good research to develop effectively so as to meet desired technical, material, and performance requirements. It may be difficult to achieve desired results or handle political priorities that arise if the desired level or performance requirement is not covered in the contract. Similarly, assumptions underlying a performance requirement should be understood. It may be helpful to allow contractual leeway and provide a communication mechanism between agency and contractor should road and weather conditions differ from those assumptions, warranting changes in desired performance.
- Performance-based specifications require follow-on procedures for verification and validation through data collection and monitoring. Performance specifications will likely improve with greater use of innovative contracting.
- A fixed payment schedule (e.g., monthly) provides the agency greater certainty in budgeting for the contract, while it transfers risk to the contractor. A hybrid payment schedule, allowing a combination of fixed payments for base conditions and unit-price payments for conditions that exceed some risk level (e.g., severe winter storms), can mitigate risk to the contractor while controlling costs to the agency. It should be understood that a schedule of fixed payments means that the contractor may receive a large monthly sum whether or not much work is done that month.
- Contractors must take on the role of decision-maker, shift from reactive to proactive management, and be prepared to share risks and rewards. The realization that there are no longer owner-specified quantities of work may be unsettling to some contractors.
- At the end of the day, trust and desire to make the contract work are needed on both sides.”

Duncan et al. (2014) noted that a number of PBMC contracts removed or chose to include snow and ice removal due to the variability of response options, the expertise required and critical importance of the work.

2.4 Equipment and Materials

The majority of transportation agencies require contractors to provide at least some of the necessary vehicles and equipment. With rare exception, most agencies do not have sufficient

reserve vehicles for contractors to use. Even if the agencies are equipped (in-house, or contractors, or both) with resources for snow and ice operations, there is always a need for additional resources such as equipment, labor force, and materials, especially during extreme weather conditions or changing weather patterns. In such instances, contractual agreements need to be clarified for both new and existing contractors. Agencies may arrange for supplemental contractors, especially those with the heavy equipment and specialized machines such as snow-melters. For example, Texas DOT supplements its agency forces with additional contractors by using routine maintenance contracts or uses small emergency purchase procedures during extreme conditions (Holland, 2012).

NCHRP Report 692 developed a systematic process for evaluating the decision to outsource fleet maintenance activities. The study realizes the importance of the availability of specialized snow and ice control equipment (trucks, spreaders, and plows) during emergencies, because it can directly affect how quickly agencies can respond to clear snow. Outsourcing such specialized equipment off-site may increase the risk of timely maintenance activities (Wiegmann et al., 2011).

It should be clarified that in this context, “contractor” refers to a commercial entity that supplies the equipment and personnel to perform the specified service. To further the distinction, “contract employee” refers to an individual who is hired directly by an agency for a defined time period and specific function. A contract employee receives an hourly wage and is paid according to time worked or, by agreement, a set amount by hours or dollar amount for “standby” time when he or she must be available for duty when summoned. In some cases a contract employee may be paid a “sign-on bonus” or an end-of-season retainer bonus. A contract employee is subject to the same work rules as regular full-time, part-time and seasonal employees but does not receive benefits. “Seasonal” employees are hired for a limited period of time as well, but may receive some benefits. “Part-time” employees may work year -round and year-to-year up to a maximum number of hours. Agencies may use one or a combination of all methods to staff their snow forces. Those employed in such manner typically use agency equipment and vehicles.

Contractors, again meaning independent commercial entities, typically have trucks and equipment used at other times of the year for construction, maintenance, landscaping, hauling, etc. Contractors are responsible for the maintenance, repair, refurbishing and replacement of and fuel for any units used for snow and ice control. These costs are usually covered in the flat rate paid by the contracting agency. Agencies have tightened contract specifications in recent years to specify the type of vehicle by size, capacity, capability (i.e., plow configurations, spreader and liquid application apparatus), minimum standards for warning lighting, communications devices, GIS and AVL, chains, etc. Agencies are also now requiring pre-award inspection of a potential contractor’s fleet to ensure that it meets safety and operational standards. Calibration of spreader/applicator apparatus is normally required as well; any repairs or adjustments are the burden of the contractor. It is recommended that such vehicle inspections and calibration checks be conducted periodically throughout the winter season, for both contractor and agency vehicles.

The majority of agencies supply material like salt and sand to the contractors at the agencies’ sites. The material must be accounted for as to how much was loaded and how much was expended. Any unused materials should be returned to agency stockpiles.

2.5 Contracting Provisions Regarding Equipment Specifications

Some of the equipment used for winter maintenance operations is unique and it is not used for other purposes throughout the entire year. As mentioned in the previous section, agencies do rely on the contractors to provide snow and ice control equipment. It is therefore important that contractors have advanced equipment technologies to meet the LOS. As an example, Massachusetts DOT (MassDOT) encourages contractors to update their fleet of equipment with modern winter maintenance application equipment through the use of financial incentives (Fay et al., 2013). MassDOT encouraged winter maintenance contractors to invest in newer closed loop spreader technology by offering an additional \$16 per hour per retrofitted truck, if done in the first three years of the request. After the three year period, all contractors were required to have this technology onboard material application trucks and the incentive program ended. The amount of the incentive was calculated based on the cost-savings related to the use of the new technology.

2.6 Training

Agencies are increasingly aware that many contractors' employees have little training on snow and ice control. This became strikingly apparent as agencies in the past decade or so realized that their own employees lacked that same training. Typically, a new operator was paired with a veteran for a short time and learned how to operate a plow truck "on the fly." What was lacking was a consistent, thorough and structured approach to educating snow plow operators, supervisors and managers on pre-trip vehicle inspections, safe driving, proper plowing techniques, spreader and liquid applicator control, properties and uses of different materials, how pavement and weather factors influence the effectiveness of materials, communications protocols, reports and how to deal with the public and the media. In particular, seasonal or part time employees do not have sufficient experience to deal with snow and ice control activities. Ann (2008) reported DOTs provide training to temporary employees on how to operate snow and ice control equipment for nearly 600 individuals prior to the winter season. Part time employees reported difficulties in performing the winter maintenance work with less training (Ann, 2008).

There are no national standards for certifying snow plow operators, agencies or contractors. However, American Public Works Association (APWA) developed its Winter Maintenance Supervisor certificate course and has trained nearly 2,000 individuals since 2012. Clear Roads is developing its own three-level course and American Association of State Highway Transportation Officials (AASHTO) has a series of CDs covering a broad scope of winter maintenance subjects. A number of DOTs and local Public Works agencies across the country have developed their own training regimens; Minnesota DOT's "snow school" is an example. Iowa DOT has a series of operator training videos available on YouTube. Alaska DOT also has some very good instructional videos on You Tube.

In Japan, new employees are taught to operate snow and ice control equipment especially on steep grades that are blanketed with ice (Wilson, 1999). By contrast in the U.S., most local and state transportation agencies conduct at least a pre-season briefing and "dry-run" for their employees. Nonetheless, what is required for agency employees should be necessary for contractors.

2.7 Monitoring and Supervision

It is important to monitor and supervise the performance of the contractors. In particular, monitoring the performance should be done by agency staff. An internal audit at Florida DOT found that “all maintenance rating programs evaluations [should] be performed with in-house forces rather than having the contractors evaluate themselves” (Duncan et al., 2014). However, inspecting a contractor’s work requires specialized skills and requires specialized training for the responsible individuals. It may also require having a camera and other technologies to monitor the performance of contractors.

In general, routine maintenance activities are not supervised by the agencies except for monitoring the work done by contractors. For winter maintenance, more monitoring and supervision may be required to increase public safety. As previously discussed, snow and ice control activities directly impact public safety, and agencies are expected to provide at a minimum remedial action. VDOT and MassDOT directly supervise and direct the number of trucks to be used, the response times, and the application rates under their outsourcing contracts for snow and ice control (Duncan et al., 2014). Duncan et al., (2014) also reported a possible trend toward excluding winter maintenance activities from performance-based contracts so that the agency retains the direct administration and control over these activities.

2.8 Importance of Geographic Area (Rural vs Urban) in Contracting

Geographic area (rural vs urban) plays another role in contracting for snow and ice control functions. It is generally perceived that urbanized areas, which have a higher density of contracting firms, are a more favorable environment to use contractors for snow and ice control functions. However, contractors may be willing to work in remote areas if the size of the contract warrants it, and total maintenance contracts are less affected by considerations of remoteness due to their larger scope and longer duration (Halcrow, 2011). Additionally, contractors located in remote areas might be willing to work as contractors in those areas (Markow, 2014). To support this, NCHRP Synthesis 329 survey noted that contracting is viable in remote areas depending upon the available resources and strategies for managerial consideration (Markow, 2014).

2.9 Benefits of Contracting

Transportation agencies consider contracting snow and ice response (or other forms of public-private partnerships) because it is expected to produce certain advantages. The following benefits have been identified by Hyman (2009):

- “Potential for cost savings
Cost reductions have been reported achieved through several mechanisms:
 - Better resource allocation/sharing risk and reward
 - Economies of scales in spreading fixed costs over a wider scope of work and longer contract period
 - Increased efficiency in raising the LOS across highway assets and services
 - Reduced unit cost of work
 - Introduction of new technology and work procedures
 - Training of subcontractors

- **Augmenting in-house capacity**
PBMC's can supplement existing agency resources when and where needed. Such as:
 - Compensating for a shortage of internal agency experience,
 - A lack of specialized skills, capabilities, and expertise,
 - Reductions in staffing.
- **Improved highway performance**
PBMC's have been used to raise the LOS provided to customers by improving:
 - Road condition
 - Service performance through increased productivity that is focused on results.
 - Road-user satisfaction promoted through achieving customer-oriented outcomes.
- **Increased innovation**
PBMC's can encourage innovation with new methods, materials, and technologies, because contractors have the flexibility to determine how to do the work. Contract provisions and administration should provide and support these incentives. There is also the opportunity to contribute to, and benefit from, a shared learning process, especially if innovations do not in fact provide improved results.
- **Supporting agency policy**
PBMC's allow for integration of multiple highway assets and types of services, all the while supporting agency policies and priorities.
- **Reduced administrative burden**
Potential reductions in agency overhead costs can be gained through contractor expertise that is available at competitive rates, and through streamlined agency administration enabled by contractors' assumption of responsibility for meeting performance targets. PBMC's can provide a single point of contact with the contractor in lieu of the several interfaces needed with single-asset contracts. Communications can be quicker, easier, and potentially more effective. PBMC's may also reduce agency burdens to carry the fixed costs of equipment ownership and highway M&O facilities.
- **Predictability of budgeted costs**
Predictability of M&O budgets can be achieved in PBMC's through a combination of:
 - Fixed payments to the contractors
 - Scope of work encompassing a number of highway assets, a reasonably long duration of the contract allowing the contractor to depreciate invested costs.”

2.10 Concerns about Outsourcing

It is generally perceived that specialized skills are required to perform winter maintenance. Agencies that outsource winter maintenance, either totally or partially may not develop or retain a sufficiently skilled workforce. In extreme situations such as the unavailability or poor performance by a contractor, the contracting agency perform remedial action especially when public safety is a concern (Duncan et al., 2014). The Florida DOT, for example, limits the amount of outsourced maintenance to 90 percent of the work so that it retains some in-house capabilities (Duncan et al., 2014). To illustrate this, the NCHRP scan tour reported an incident in which a contractor did not have all of its equipment during an early-season snowstorm (due to equipment located in another location).

Duncan et al. (2014) reported another concern related to methods used by the contractor during maintenance activity. In a PBMC, the contractor takes full responsibility of maintenance activities while trying to attain the specified LOS. However, methods used by contractors may differ from traditional or environmentally friendly methods. For winter maintenance activities, the contractor's choices regarding application rate, product type, and timing of application of snow and ice control products may result in unintended impacts to highway infrastructure and the surrounding environment.

2.11 Cost, Performance, and Level of Service Comparison Between In-house and Contractors

Performance measures can be objective or subjective, or a combination of both. As contracts become more outcome-based, performance measures tend to be more objective. For example, in Finland the performance measure used for snow removal for contracted services states that the contractor will remove snow unless there is less than 1 cm and the skid resistance is <0.3. Additionally they must respond within 2 hours and achieve snow removal and skid resistance targets/standards within a prescribed amount of time after the storm ends (Hyman, 2009).

For winter maintenance activities, Duncan et al. (2014) notes the difficulty in establishing standard performance outcomes that are easily measurable and fair to the contractor. For example, VDOT unbundled the winter maintenance contracts from its large-scale outsourcing contract. VDOT contracts stipulate the number of trucks to be used, the response times, and the application rates. Duncan et al. (2014) reported a possible trend toward excluding winter maintenance activities from performance-based contracts so that the transportation agency retains the administration and control over these activities in-house.

NCHRP synthesis 389 also identifies the complexities in setting clear standards for snow removal contractors when using PBMC. It can be achieved in a number of ways (Hyman, 2009):

- Use same standards as in-house staff
- Compare performance with other states, provinces and countries
- Use benchmark provided by research studies
- Set stretch goals (Initial agreeable targets and increase targets based on technological change)

Additionally, evidence of PBMC resulting in improved LOS is not clear. Based on case studies, Hyman (2009) reported three type of outputs from PBMC:

- Improved the LOS for asset conditions that had low quality of service.
- Same LOS as in-house staff. For example, Canadian provinces that use PBMC do not separate the outcomes achieved by in-house staff and private contractors.
- Decreased performance in the first few years of contract and then improved performance. For example, Maryland reported a sub-par performance by contractors during their first snow-event.

For routine maintenance activities, studies also show that PBMC can be more cost effective when compared to conventional contracts. For example, Pakkala et al. (2007) reported PBMC

produced cost savings of 10% to 40% for various countries. Two of the main reasons for achieving such savings are the long duration of the contracts and the innovation used by contractors to attain specified LOS. However, the *cost effectiveness of contracting winter maintenance activities is unclear*. NCHRP scan tour reported “some agencies do not include the cost of snow and ice removal in multiyear performance-based contracts because of the unpredictability of forecasting the number of weather events that will occur”. In addition, the higher level of service expected from a contractor compared to in-house services, adds complexity to the cost calculation. In fact, the scan tour conducted for NCHRP scan tour was not able to obtain any documentation for the cost savings due to the contracted services (Duncan et al., 2014). Halcrow (2011) compared cost estimates for snow and ice removal between Nevada DOT and contractors. Nevada DOT costs ranged from \$183.15 - \$266.75/hr for snow and ice removal. Estimates for similar work by contractors ranged between \$195 - \$235/hr (Halcrow, 2011). However, the *benefits of using in-house versus contracted services may be more qualitative than quantitative*.

2.12 Quality Control Measures and Performance Indicators Used by Agencies

Agencies need to have well defined quality control measures to ensure that contractors are providing the best possible LOS for the public. This can be achieved with well-defined goals and objectives for contractors. For example, the TAMS contracts used by Virginia DOT (which include public-private partnerships) are 5-year contracts, with renewable options for two successive 2-year periods. TAMS contracts monitor contractor performance in two ways: daily timeliness and maintenance rating program (MRP) evaluation. For winter maintenance operations, performance requirements include:

- Keeping all travel lanes, turn lanes, intersections, shoulders and interchanges, enforcement areas, and police parking locations free of snow and/or ice.
- Prior forecasting to determine the requirement of anti-icing and applications of brine or salt
- Specified time periods to remove snow and ice.

VDOT also imposes penalties for failure to meet the specified standards (Markow, 2014).

A privately funded study that summarized the performance measures, or outcomes, used by contracting agencies found that in most cases, agencies measured performance of a contractor based on the available staff, number of snow and ice control equipment, and minimum capacity of the contractor (Bourdon, 2001). Other performance measures used included the number of lane-miles/kilometers plowed, sanded, and application rate. However, outcome based level of service was not commonly measured by the agencies. Maine DOT requires contractors to schedule work “such that by noon of the day following the end of the storm, three and a half (3 ½) feet of the pavement will be exposed on each side of the centerline” (Bourdon, 2011). MnDOT measures the performance of its in-house staff using a “Regain Time standard for each road classification, i.e., how long it takes them to achieve a given winter maintenance service level of bareness after a storm event is over” (Bourdon, 2011). VDOT specifies that the contractor must achieve bare pavement within 24 hours after the completion of storm.

The Ontario Ministry of Transportation (MTO) has established responsibilities for contractors, which include: address hazards immediately, use all available resources to access weather conditions, keep highways safe, and ensure that contracting staff are aware of the outcome targets. Examples of MTO's performance-based outcome targets include (Markow, 2014):

- **Level of Service - Bare Pavement:** Achieve bare pavement on a given class of highway within N hours after the end of the winter event. (N depends upon the class of paved highway.)
- **Level of Service – Snow Pack:** Achieve a snow pack condition on any route of Class 5 highways within 24 hours after the end of the winter event.
- **Ground Frost During Transition Periods:** No ground frost on roadway causing slippery conditions during transition periods.
- **Snow Accumulation near Median Walls:** Snow accumulation adjacent to median barrier walls shall be removed prior to the end of the winter event.
- **Snowbanks:** Snow accumulation at any location impairing visibility shall be removed or lowered within 48 hours after detection or being made aware.
- **Pedestrian Sidewalks:** Sidewalks shall be cleaned and sanded/ salted within 24 hours of the end of the winter event.

2.13 Review, Revision and Termination of Snow and Ice Response Contracts

After implementing snow and ice response contracts, some agencies eventually revert back to the use of in-house forces. In other cases, agencies revise the methods used for contracting the work for snow and ice control. The reasons for these changes provide lessons learned that may be instructive to other agencies.

In a study by Hyman (2009), the most frequent approach for penalizing contractors who did not meet the performance standards was the use of lump-sum deductions. The study also highlighted the need for a balanced approach, including both incentives and disincentives (Hyman, 2009). In addition, transportation agencies have few alternatives when contractors fail to adequately provide snow and ice control. When contractors, particularly smaller firms, encounter mechanical problems or personnel shortages, they often don't have backup equipment or drivers. If the contractor can't respond in a reasonable time then the agency may have to reassign its trucks or a different contractor to cover. This considerably stretches resources and causes delays in servicing other areas. Furthermore, some contractors are financially unstable and may go out of business during the season. In such cases, performance bonds may be required for contractors to provide some protection or remedy to the agency.

It should be clearly stipulated in the contracts that the agency's work takes precedence over any other work of the contractors. Many firms that contract with public agencies for snow removal from public right-of-way also have contracts for private property like stores, shopping centers, office buildings, and major institutions. It must be a firm obligation that the agency's call has highest priority.

In a recent study, the City of Prince George, Canada hired Mercury Associates, Inc. to evaluate several facets of the management and operation of the fleet that are used for snow and ice control operations (Mercury Associates Inc., 2014). As a part of an equipment review, the study

reviewed the conditions and capabilities of the contracted resources. Interestingly, the study found that most of the equipment used by contractors was either completely worn out and needed to be replaced or was significantly worn out and needed to be refurbished. The study recommended not using contracting services for the 2014 – 2015 winter season and suggested including equipment age as a factor in awarding future contracts. For equipment rental agreements, offering retainers was suggested to obtain a reliable supply of rental equipment (Mercury Associates Inc, 2014). In 2002, Oklahoma voided its five contracts with Virginia Maintenance Services, Inc. due to poor performance in routine highway maintenance including snow and ice control. In response, “*Senate Concurrent Resolution 73 passed in May 2002, expressing legislative opposition to outsourcing routine highway maintenance, including snow and ice removal*” (Ribreau, 2004).

CHAPTER 3: SURVEY SUMMARY

A total of 51 respondents participated in the survey representing 31 U.S. states and three Canadian provinces (Alberta, Ontario and British Columbia). Survey responses were from state/province DOT (87%), county Public Works/DOT (4%) and Municipal Public Works (6%). Other responding groups included a private maintenance contractor. The total lane-miles and total snow and ice control lane-miles maintained by responding agencies ranges from 800 to 77,000 lane-miles.

The following section provides a summary of the survey results. The survey questionnaire can be viewed in Appendix A, and the detailed results of the survey including individual responses are provided in Appendix B.

3.1 Background Information

Of the 51 survey respondents, about 60% (31 responses) use contracted services and 40% (20 responses) do not use contracted services for snow and ice response. A majority of the respondents who use contracted services hire private or commercial contractors for snow and ice response. Very few respondents indicated using local public agency staff or a combination of both private and local public agency staff for snow and ice response. Survey respondents provided various reasons for not contracting snow and ice response such as:

- Increased cost
- Variation in response time
- Reduced level of service
- Non-availability of contractors
- Non-availability of specialized equipment and labor from contractors
- Surplus and efficient in-house staff
- Limited agency contracting system

Additionally, some agencies mentioned using contracted services only during emergency situations.

3.2 Reasons and Type of Contracting

Survey respondents provided various reasons for contracting snow and ice response. In particular, about 50% of the respondents indicated that lack of agency resources, specifically caps on labor and equipment, as the main reason for using contracted services. About 25% indicated that there has been a state-level movement toward privatization through legislative action and an effort to reduce costs by using contracted services as the reason for using contracted services. Another 20% of respondents indicated difficulty in retaining and replacing skilled workers and 16% indicated added lane mileage as the reason for using contracted services. Additional reasons for using contracted services include:

- If state highways go through a city, agencies contract with the city to conduct snow removal operations.
- During extreme winters (limited contracting only).

- To meet the level of service (12-hour completion time).
- Limited use for snow and ice control equipment during the summer months.

Nearly half of the respondents contract for equipment and operators during normal winter circumstances and use long term contracts (up to 5 years or more). About one-third of the respondents use short term contracts (1 to 3 years), fixed lump sum (fixed annual payment of estimated expenditures regardless of winter severity) contracts, and blended forces contracts (in-house and contracted services working together) for snow and ice control. Responding agencies indicated they design or establish contracts that are specific for winter maintenance (63%). Only about 25% of the respondents indicated they combine winter maintenance contracts with year-round maintenance contracts. Other types of contracts provided by respondents included hourly contracts, and winter only contracts, or emergency contracts. One agency indicated giving the option to the local agency to choose between year-round and winter only contracts. In addition, respondents indicated either contracting all the snow and ice roads/routes to contractors or contracting only a few selected snow and ice roads/routes to contractors.

3.3 Qualifications and Training

Pre-qualification refers to the contracting agency's minimum requirements for prospective contractors to meet in finances, staffing, equipment, length of business experience, and insurance requirements. Around 60% of the survey respondents noted that their contractors are pre-qualified and another 40% of respondents indicated that the contractors are not pre-qualified. Pre-qualification criteria provided by agencies included: sufficient insurance, number of staff and equipment, equipment inspections, similar experience (to in-house staff), and cost quoted. Interestingly, one respondent indicated having a three-tier system requiring the contractor to pass each tier based on the point system, to ultimately qualify for the contract.

In terms of experience, about half of the survey respondents indicated that the contractors' personnel must have experience and/or approved training in snow and ice control, while the other half did not require either. Similarly, about 50% of the respondents indicated the contractors, or funding agency, do not require additional training for personnel after the contract is awarded. Examples of the experience and/or approved training required by agencies included: commercial driver's license (CDL), two years of plowing/spreading experience, and training from contractors or agencies prior to winter season. Furthermore, *most respondents indicated that training/certification or recertification is not required* of contractors' staff except for two respondents who indicated recertification is required once a year and once every two years, respectively.

3.4 Geographic Location

About 65% of responding agencies use contracted services for both urban and rural locations. Another 20% of the responding agencies use contracted services only for rural areas (includes major highways and low volume roads) and the remaining 15% of the responding agencies use contracted services only for urban areas (includes arterial streets, collector streets, and parking lots). From these survey results, there was *no relationship between finding contractors and types of geographic locations* (e.g., urban vs rural). In other words, some agencies had difficulty in

finding contractors and others have multiple contractors to select from irrespective of their location in a rural or urban area.

3.5 Equipment and Snow and Ice Control Materials

Equipment for snow and ice control is most commonly single-axle and tandem-axle dump trucks fitted with plows and spreader bodies. The majority of the responding agencies (88%) indicated contractors provide the equipment used for the snow and ice control operations. Similarly, responding agencies (83%) indicated that contractors are responsible for equipment calibration. Additionally, the majority of the responding agencies (72%) stated that a contractor's equipment needs to be maintained to meet specific standards. Some of the standards required by agencies for contractor owned/operated equipment included routine mechanical inspections and calibration for spreaders (supervised by agency staff).

Advanced technologies used in snow and ice control may include GPS/AVL and closed loop spreaders. About 20% of respondents indicated that their agency does provide incentives to encourage the use of advanced technologies. Common incentives provided by the responding agencies included increase in pay rate or bonuses. In some cases, advanced technologies are mandated as a part of the contract or agencies provide the advanced technologies.

More than half of the respondents (55%) indicated that the agency provides the snow and ice control materials (salt, sand, liquid chemicals, etc.), while 20% of the respondents indicated that the contractor provides the snow and ice control materials. Respondents also mentioned situations where contractors purchase some of the snow and ice control materials and agencies provide the other snow and ice control materials. One respondent mentioned local agencies were given the option to procure products, with the reimbursement of the cost being based on the amount of salt used.

3.6 Cost, Performance, and Level of Service

Performance Based Contracting Method (PBMC) is a contracting method that provides incentives and/or disincentives to the contractor to achieve desired outcomes or results. More than half of the respondents (52%) indicated that they have never used PBMC and have no plans to implement this contract type in the future. PBMC is currently in use by only 16% of the respondents but an additional 16 have plans to implement PBMC in the future. In terms of quality control measures, 50% of the respondents indicated they have a formal quality control measure and/or performance standards. Some of the formal quality control measures and/or performance standards mentioned by agencies include:

- Having a quality assurance supervisor.
- Meeting requirements mentioned in Department's Maintenance Manual and/or established snow and ice control guidelines.

An Operational Plan may be submitted if the local agency (counties/municipalities) contracts snow and ice control with the state DOT. An Operational Plan identifies the work limits, expectations, time to respond, and any extra work (snow fences, parking lanes, etc.) required by the contract for the local agency to complete. About three-quarters (74%) of the respondents

indicated that contractors do not need to submit an Operational Plan to the agency. Conversely, 26% of the respondents indicated that contractors must submit an Operational Plan.

For application rates, about 60% of the respondents indicated that agencies provide guidance for application rates to the contractor, and about 38% of the respondents indicated that application rates are monitored as a part of the contract. Of these, about 33% of the respondents indicated that specific application rates are given to the contractor as guidance. About 12% of the responding agencies indicated that the contractor determines and is responsible for tracking application rates. One respondent indicated they do not provide or track application rates.

With regard to performance standards, 60% of the respondents use the same standards for contractors as for in-house staff. While 20% of the respondents indicated that they do not set any performance standards, 8% of respondents compared performance with other similar agencies, and another 8% of the respondents set stretch goals (initial agreeable targets and increase targets based on technological changes).

For quality control measures (QCM), respondents were asked to select all measures that apply. "Specified time periods to respond for a winter event," was the highest ranked measure (75%), followed by "Highways clear within a certain time after the end of a winter storm," (67%). Additionally, 33.3% of the responding agencies consider the need to remove snow and/or ice (at a minimum) at specified locations as an important QCM. Prior forecasting and anti-icing is used as a QCM by about 20% of the agencies. One responding agency indicated using specified friction levels as a QCM. Finally, 25% of the responding agencies do not have any QCM to measure the performance of the contractors.

In comparing contracted services to in-house services, about 40% indicated that the same level of service (LOS) is achieved with contracted services as in-house services. Another 28% indicated a decreased LOS with contractors compared to in-house services. None of the responding agencies experienced improved LOS with contracted services compared to in-house services. About 58% of respondents do not provide incentives/disincentives based on the performance of the contractors; however, some respondents imposed penalties for non-performing contractors.

About 41% of respondents experience an increase in cost due to contracted services, 12% experience a decrease in cost, and another 12% indicated no difference in cost. However, comments provided by the respondents show that agencies tend to associate cost with the level of service. Only about 25% of the respondents indicated that they did perform a formal cost-benefit analysis between contracted services and in-house services. In particular, one respondent found after performing extensive cost analysis that utilizing state employees for snow and ice response is more cost effective.

3.7 Emergency Deployments

In terms of emergency deployments (during extreme weather conditions - snow events, flooding, etc.), about 32% of the respondents indicated that it is the responsibility of contractors to deploy additional resources (at additional cost paid to the contractor by the agency) during emergency deployment. About 26% of the respondents indicated that it is the responsibility of contractors to deploy additional resources and bear the additional cost. Approximately 16% of the respondents

indicated that the agency provides additional resources (labor and equipment) from other parts of the state to contractors. Finally, 26% of the respondents indicated emergency deployments are not required by contracted forces.

In situations where contractors are not responsible for emergency deployments, 30% of the respondents indicated that the agency recruits additional contractors only for emergency deployments and 20% of the respondents indicated that the agency uses its own resources to coordinate emergency deployments. However, none of the responding agencies provides additional short term subcontracts to address the added cost. One respondent indicated bringing resources from unaffected districts during emergency deployments.

3.8 Safety

Some agencies set safety standards for the contractors employed during snow and ice response. About 65% of the respondents indicated that they set safety standards for the contractors employed during snow and ice response. Another 35% of the respondents indicated that they do not set any safety standards for the contractors employed during snow and ice response. Some of the safety standards set by agencies include speed monitoring, drug and alcohol testing, lighting requirements, and holding a Commercial Driver License (CDL).

When asked about accident rates between contracted versus in-house forces, respondents either think that there is no difference in accident rates or they do not track accident rates. However, one respondent mentioned there is a greater chance of accidents with the use of contractors. Seventy percent of responding agencies indicated that contractors are responsible for any damage (life and property) during snow and ice control. In some cases, the state agency pays for the local agencies as long as the contractor does not disregard safety operations.

3.9 Issues with Contracted Services

About 86% of the respondents indicated that they have not reverted from using contractors back to state agency resources, while about 14% of the respondents indicated that they have partially reverted back to using agency resources. Interestingly, none of the agencies completely reverted back to using agency resources all of the time, mostly related to non-availability of replacement contractors.

In addition, 50% of the respondents indicated that they have had to terminate a contract within the last 5 years. Another 50% of the respondents indicated that they did not have to terminate a contract within the last 5 years. One common reason given for terminating a contract is due to non-performance and/or poor performance by the contractors.

Over half, 52%, of the respondents indicated that they have never had a contractor terminate a contract, while 48% of the respondents indicated that they have had situations where contractors terminated a contract. The reasons given by the responding agencies for contractors terminating a contract include bankruptcy of contractors, contractors out of business, and dissatisfaction with the pay by agencies.

Specific lessons learned by agencies with contracting snow and ice control mostly relate to mutual understanding between the contractor and the agency. Some of the comments provided

by agencies include more comprehensive contracts with specific details for equipment, monitoring of snow and ice control equipment and materials, trained personnel to manage the contractors, and inclusion of expectations. Interestingly, one respondent mentioned giving up control and direction to the contractors, to give contractors a sense of ownership.

CHAPTER 4: SUMMARY OF FINDINGS

4.1 State DOT Contracting Practices

Snow and ice control requires instantaneous and efficient response paired with reliable availability of equipment and manpower. Response times are crucial and every storm event is different, demanding flexibility in the use of limited resources. Unpredictable winter weather has a profound effect on the overall value of work related to snow and ice control. Some budget cycles see double or triple the expected expenditures based on the intensity and duration of snow events. With this uncertainty, and the importance of maintaining mobility in winter conditions, many states have adopted alternative delivery approaches for winter maintenance activities. While contracting does not shift the costs of winter maintenance snow response entirely to outside parties, the contracts are used to provide some stability and ensure an appropriate response.

4.1.1 Common Practices

Effectively clearing and deicing major roadways can reduce traffic collisions and single vehicle crashes by up to 90% (Kuemmel, 1992). In most states, the cost of a full season of snow fighting equals less than the cost of a single day of economic activity lost to winter storms (Salt Institute, 2000). Millions of dollars are lost or saved depending on the response to snow and ice on transportation infrastructure. States offer many reasons for choosing to provide additional contract labor for snow and ice removal and other winter operations. Prior research demonstrated that the primary reason for contracting snow and ice control operations was a lack of in-house resources, measured in both human and financial resources (Warne, 2003). This lack of resources is magnified by increased workload and changes in the commonly acceptable levels of snow removal (e.g. states that adopt a bare lane policy have customer expectations that require additional attention to snow and ice removal). Movement to performance based operating policies mandate goals and objectives that extend beyond the level of service states can provide with in-house resources. In many cases, unusual storm events have amplified the calls for additional attention to snow and ice removal.

Seasonal variations in staffing – as determined by the increased working hours needed during the winter season, coupled with reduced maintenance requirements throughout other times of the year – also motivate state practices. Past research identified many examples of staffing imbalances, due to these seasonal changes in job duties (Duncan et al., 2014).

Other contracting motivations have been cited extensively in the literature review for this project. Some of these include state legislative or executive pressure to reduce workforces and privatize certain maintenance functions, staffing retention and training issues, and overall cost or performance related issues.

Survey respondents provided their reasons for contracting snow and ice response as part of this study effort. For the most part, the survey respondents paralleled the primary findings of past literature. Approximately 50% indicated a lack of agency resources, with a specific discussion on established caps on labor and equipment. About 25% indicated that there has been a state-level movement toward privatization through legislative action and an effort to reduce costs by using

contracted services as the reason for using contracted services. Another 20% of respondents indicated difficulty in retaining and replacing skilled workers and interestingly, 16% indicated that added lane mileage was a primary motivation for using contracted winter maintenance services. Additional reasons for using contracted services include:

- If state highways go through a city, agencies contract with that municipality to conduct snow removal operations.
- During extreme winter events (limited contracting only)
- To meet the level of service (12-hour completion time)
- Limited use for snow and ice control equipment during the summer months.

4.1.2 Effective Practices

Many effective practices are evident to maintain consistency and provide an appropriate level of service for contracted snow and ice control operations. For example:

- New York adopted lump sum payments to guarantee a base level in its contracts with various town, village, and county highway departments.
- Wisconsin contracts with each county for maintenance activities and notes that over 1500 snowplow drivers are available with 770 assigned full-time for snow removal.
- Many Canadian provinces have established clear level of service performance criteria to encourage a robust market for a variety of maintenance outsourced activities.
- Massachusetts DOT and Nevada DOT established a set of minimum thresholds to encourage wide diversity in plowing contractors and ensure a level of expected availability.
- Georgia DOT, in response to unusual snow events, has expanded its list of available contractors and completes “dry runs” in response to snow events.
- New Jersey has expanded its vendor opportunities and advertised on variable message signs to encourage a wide range of contractors.
- Minnesota uses in-house forces but created a competitive performance driven approach.

Overall, the most effective practices include *a working partnership between the state and the contractor*, either public or private. *Clear communications* strategies and *contract terms and conditions* allow for continued dialogue and prevent unnecessary conflicts from arising. Performance standards for various storm durations should be determined which will dictate associated labor, material, and equipment needs. Clear and concise contracts explaining the scenarios when a contractor would be used need to be drawn. Contracts also should include specified notification procedures and include stand-by operations. Agencies should adopt contract language that maximizes the opportunity and responsibility for the contracted party to prove responsiveness, efficiency and/or effectiveness in producing snow and ice response to the public. After all, if the contractor fails to perform, the state will ultimately be responsible for initiating corrective action.

4.1.3 Motivations for Not Contracting Snow and Ice Response

Several U.S. states continue to provide snow and ice control operations without contracting outside of the agency. Colorado, Montana, North Dakota, Utah, and others provide winter maintenance services exclusively with in-house staff. In some cases, this decision is based on

cost-effectiveness, however, few cost comparisons specific to winter operations n have been published.

About 41% of survey respondents indicated that they experienced an increase in costs with contracted services, 12% experienced a decrease in cost, and another 12% indicated no difference in cost. However, comments provided by the survey respondents show that agencies tend to associate cost with the level of service. About 25% of the respondents indicated that they did perform a formal cost-benefit analysis between contracted services and in-house services. In particular, one respondent found after performing extensive cost analysis that utilizing agency employees for snow and ice response is more cost-effective.

Some agencies have terminated maintenance contracts due to unsatisfactory experiences. In these cases, poor performance led to changes in the outsourcing activities. For example, the Illinois Tollway discontinued a snow and ice removal contract at its facilities due to customer complaints and poor vendor response. Quality of service can be diminished unless contract terms are performance based. *Our survey found that 50% of respondents had terminated contracts due to poor performance*, while 14% of respondents indicated that they had partially pulled back certain maintenance activities to in-house staff.

Legal requirements can limit the ability of some states to contract for snow and ice response. States that have limitations on bidding processes or require substantial insurance and bonding levels will likely not have a robust contracting stable available for snow and ice control operations. Additionally, in certain geographic regions, limited competition has caused concerns – in particular, one state reported that a contractor going out of business required state maintenance personnel to cover winter maintenance activities in that area.

Some states report that because the maintenance personnel live in the areas where they perform snow and ice removal, a high level of quality service is maintained at reduced cost. They noted that by removing a profit motive, “corners are not cut.”

Finally, contracting snow and ice response can erode the body of knowledge maintained within the agency – this institutional knowledge is dependent on workforce management practices. *The most commonly cited factor for states to resist contracting services was the desire to retain key skills and expertise*. State DOTs recognize that they need to maintain a core of employees with sufficient winter maintenance experience and expertise to be able to effectively oversee and manage consultants and contractors and to also develop the expertise of more junior highway department employees. Dependence on contractors increases as in-house expertise and capacity is diminished. This loss of leverage could lead to increased prices in future negotiations.

4.1.4 Lessons Learned

The primary observation for contract success is communication – clear, open, and honest partnerships between the state and vendors assures that a dialogue is available and issues can be addressed quickly and effectively. The overall goals of both the contractor and the agency need to be the same to ensure success. Partnerships even require some willingness to compromise and relinquish controls to allow a shared sense of ownership.

Contract language and type is also a determining factor. The following section provides additional details on type and duration, but a comprehensive contract detailed enough to explain what the state's needs are and what specifically is required from the contractors to meet those needs is essential.

Additional lessons learned by agencies with contracting snow and ice control operations mostly relate to mutual understanding between the contractor and the agency. Some of the comments provided by agencies include monitoring of snow and ice control equipment and materials, trained personnel to manage the contractors, and inclusion of expectations.

4.2 State DOT Procurement Methods for Contracting

4.2.1 Contracted Services

In North America, transportation agencies typically procure contractors for snow and ice control operations either *from the private sector or from local public agencies*. Private sector hires includes the private and commercial contractors and local public agencies including the state's respective cities, counties, and municipalities that are involved in roadway maintenance operations. Private sector hires are commonly used by state DOTs for contracting snow and ice operations.

State DOTs hire private contractors or local public agencies for snow and ice control. The majority of states are using private contractors.

Survey responses indicated that the majority of the states (about 75%) that contract snow and ice response hire private or commercial contractors. Only about 20% of the responding states that contract snow and ice response use local public agency staff. A very limited number of respondents contract with both private and local public agency staff for snow and ice response.

4.2.2 Type of Contracts

NCHRP Synthesis 313 conducted a detailed survey and found that U.S practitioners typically use four types of contracting methods.

1) *Rental Agreements or Short-term Contracts*

This type of contract involves the use of rental agreements or short-term contracts only in extraordinary circumstances, such as severe storms or to haul away excess snow that has been plowed to the side of the road. In addition, agencies hire local individuals with equipment as temporary state workers only for winter months to supplement their full-time employees (Markow, 2014). The survey conducted for this study determined that this type of contract is commonly used by responding agencies. In addition, responding agencies use different types of agreements within these contracts, which typically fall into three categories:

- Fixed annual payment based on the estimated expenses regardless of winter severity or hours invested.
- Hourly payment for labor and equipment with some guaranteed minimum payment.

- Indexed Lump Sum Contracts are paid per lane mile for estimated expenditures with adjustments for change in scope of work (harsher or mild winters) with a guaranteed minimum payment.

It should be noted that not all the contractors who received hourly payment were given guaranteed minimum payment amounts. For example, one responding agency provided guaranteed minimum payments only for the six lowest bidders out of their 20 potential contractors to encourage lower bids.

2) *Defined Amount of Work or Recurring Work Contracts*

The second type of contracting involves a defined amount of work on a recurring basis for a particular agency, which may include contracts with local agencies (county or city), private individuals, or firms to provide snow and ice control on state routes (Markow, 2014). Local agencies (municipalities and counties) using this type of contract are often reimbursed for the cost of using the equipment, materials, and workers without profit (Duncan et al., 2014). The survey results indicate that this contract type is typically used with local agencies. Moreover, these types of contracts are long term and in some cases local agencies receive indexed payments.

3) *Blended Forces*

The third type of contracting service involves the use of both state forces and contractors for snow and ice operations, with contractors handling the majority of the effort statewide (Markow, 2014). From the survey responses, about one-third of the respondents indicated using this type of contract. The contractor is either a private firm or a public agency. These contracts are generally used during extraordinary circumstances to provide additional support.

4) *Public-Private Partnership Contracts*

The fourth type of contract involves the use of more comprehensive contract mechanisms for snow and ice operations, including asset management contracts and public-private partnerships (Markow, 2014). Results from the survey indicate that this contract type is not commonly used by responding agencies, with only about 12% of the responding agencies using Public-Private partnership contracts for snow and ice control operations.

4.2.3 Duration of Contracts

Duration of contracts plays a significant role in the success of contracting especially in snow and ice control operations. Contractors need specialized skills and may require time to learn those skills compared to routine maintenance operations. Work by Hyman (2009) reported that *contractors initially showed decreased performance within in the first few years of a contract, after which time performance improved significantly*. In the state of Maryland, sub-par performance by contractors during their first snow-event was reported. This clearly shows the contractors need training and time to learn as they go in the first few snow events. Conversely,

Contractors may need to be given enough time to learn the skill of snow and ice control operations and also make a return on their investment.

contractors should be given sufficient time to make a return on their start-up investment expenses. Maine DOT uses three-year contracts for snow and ice control with an option for a three year extension based on the success of the existing contractor (Duncan et al., 2014). Alberta Transportation and Utilities (AT&U) of Canada provides five-year term contracts for its winter maintenance operations. The longer contract times allows contractors sufficient time to make a return on their initial capital investment (Bucyk and Lali, 2005). From the survey, *about 45% of survey respondents indicated using long term contracts (up to 5 years or more), while 35% indicated using short term contracts (up to 3 years)*. In addition, *about two-thirds (62.5%) of the respondents indicated establishing separate snow and ice contracts, instead of combining winter maintenance contracts with year-round maintenance contracts*. This may indicate the need for agencies to have contractors with specialized skills or to develop specialized skills in snow and ice control operations.

4.2.4 Qualification and Training

Pre-qualification refers to contractors meeting requirements set by the agency in finance, staffing, equipment, length of business experience, insurance, and other areas. *Around 60% of the survey respondents noted that their contractors are pre-qualified and another 40% of respondents indicated that the contractors are not pre-qualified*. Pre-qualification criteria required by agencies included:

- Sufficient insurance,
- Number of staff,
- Inventory of equipment,
- Equipment inspections,
- Similar experience (to in-house staff),
- Cost quote.

One respondent indicated having a three-tier rating system, requiring the contractor to pass each tier based on a developed point system, before qualifying for the contract. The three-tier rating system is described below.

- Tier one: Contractor demonstrates sufficient insurance and bonding. Result will be pass or fail. Contractor has to pass to advance to the next tier.
- Tier two: Service proposal demonstrating the approach to the work (number of plows, number of staff, where the yards will be located, etc.). The service proposal is worth 30% of the final score (out of 100). Contractor must get a minimum of 15 points to advance to the next tier.
- Tier three: Based on the cost quote. The cost proposal is worth up to 70% of the final score (out of 100).

- The contractor with the most points will be awarded the contract.

Most state agencies do not have demanding pre-qualification and training criteria for contractors involved in snow and ice control.

Petty (2008) reported various DOTs provide training to temporary employees on how to operate snow and ice control equipment for nearly 600 individuals prior to the start of the winter season. Part time employees reported difficulties in performing the winter maintenance related work with less training (Petty, 2008). From the survey, *about half of the survey respondents indicated that the contractors' personnel need to have experience and/or approved training, while the other half indicated that the contractors' personnel do not need experience or training in snow and ice control.* In addition, *about 50% of the respondents indicated the contractors, or funding agency, do not require additional training for personnel after the contract is awarded.* Some of the examples of the experience and/or approved training required by agencies includes:

- Commercial driver's license (CDL),
- Two years of plowing/spreading experience, and
- Training from contractors or agencies prior to winter season.

Furthermore, most respondents indicated that training/certification or recertification is not required of contracted staff except for two respondents who indicated recertification is required once a year and once every two years, respectively. This means that many agencies are hiring contracted employees who may have little or no training in snow and ice control operations. In particular, seasonal or part time employees hired through contractors may have insufficient experience to adequately handle snow and ice control activities.

4.2.5 Equipment and Snow and Ice Control Materials

The majority of agencies require contractors to provide at least some of the necessary vehicles and equipment for patrols and routine snow and ice control operations. With the rare exception, most agencies do not have sufficient reserve vehicles for contractors to use. Even if the agencies and contractors are equipped with the necessary resources for “normal” snow and ice control operations, this is often not the case for extreme events where there may be a need for additional equipment and materials in specific locations. Agencies may arrange for supplemental contractors, especially those with the heavy equipment and specialized machines such as snow-melters. For example, Texas DOT supplements their agency forces with additional contractors by using routine maintenance contracts or small emergency purchase procedures during extreme conditions (Holland, 2012). Conversely, outsourcing snow and ice control equipment to any off-site contractors may increase the risk of timely winter maintenance activities (Wiegmann et al., 2011)

Private contractors tend to use their own equipment while contracted local public agencies share their equipment with the state DOTs.

From the survey, the majority of the responding agencies (88%) indicated private contractors provide the equipment for the snow and ice control operations. However, a very small percentage

(12%) of respondents indicated that both the agency and local public agency contractor provide equipment for the snow and ice control operations. None of the respondents indicated having the agency alone providing equipment for the snow and ice control operations.

In terms of equipment calibration, most of the responding agencies indicate that *contractors are responsible for equipment calibration*, with the exception of one respondent who indicated that the agency is responsible for equipment calibration. Interestingly, about *12% of survey respondents indicated that no equipment calibration is required*. Some of the standards required by agencies for contractor owned/operated equipment included routine mechanical inspections and calibration for spreaders. Advanced technologies, such as GPS/AVL and closed loop spreaders, were not commonly suggested or required by responding contracting agencies. Only about 20% of respondents indicated that their agency provides incentives to encourage the use of advanced technologies. Common incentives used include increase in pay rate or bonuses. In some cases, advanced technologies are mandated as a part of the contract or agencies provide the advanced technologies.

The majority of agencies supply materials such as salt and sand to the contractors from the agencies' sites. More than half of the respondents (55%) indicated that the agency provides the snow and ice control materials (salt, sand, liquid chemicals, etc.), while 20% of the respondents indicated that the contractor or local agency provides the snow and ice control materials. Some of the procuring options for snow and ice control materials provided by the responding agencies include:

Private contractors are most commonly provided with snow and ice control materials by agencies, while contracted local public agencies are encouraged to purchase their own materials and then be reimbursed.

- Contractors purchase some of the snow and ice control materials and agencies provide the remainder.
- Local agencies were given the option to procure materials and be reimbursed for the cost based on the amount of salt spread by the trucks.
- Contractors purchase the snow and ice control materials and the agency shares the risk of the material being used during extreme weather conditions and that the quantity is sufficient.

4.3 Cost Comparison

The cost of contracting snow and ice control operations may be higher than the cost of using in-house services, but cost-effectiveness is most often associated with the level of service. NCHRP scan tour reported “some agencies do not include the cost of snow and ice removal in multiyear performance-based contracts because of the unpredictability of forecasting the number of weather events that will occur” (Duncan et al., 2014). To support this claim, *the majority of the agencies responding to the survey indicated that they do not perform any cost-benefit analysis between contracted services and in-house services used for snow and ice control operations.* The two survey respondents who did perform a cost-benefit analysis reported:

It is not clear if the costs of contracting snow and ice control operations are greater than using in-house services. Cost information is not often compared and confounding factors such as LOS expectations complicate the analysis.

- 1) An increase in costs when using contracted services (using a basic hourly rate comparison) [New Hampshire DOT].
- 2) A 30 to 40% increase in costs when using contracted services (based on an extensive cost analysis) [Massachusetts DOT].

About 40% of agencies responding to the survey think there is an increase in costs when using contracted services, but this is not based on a cost analysis. In contrast, some responding agencies believe that the costs of contracted services are comparable or less than in-house services and that the increase in costs is associated with an expectation of a higher level of service from the contracted services. The higher level of service expected from a contractor compared to in-house services adds complexity to the cost calculation. In fact, the scan tour conducted for NCHRP scan tour was not able to obtain any documentation showing cost savings from the use of contracted services (Duncan et al., 2014). Interestingly, one survey respondent indicated a willingness to pay any additional costs associated with the use of contracted services, rather than having to maintain more in-house services and equipment for a limited amount of work.

4.4 Safety Issues and Experiences

Safety is an important issue while contracting snow and ice control operations. Crashes, such as plowing, during winter maintenance operations are commonly reported by State DOTs. For instance, Ohio Department of Transportation (ODOT) reported 63 crashes statewide involving snowplows in just one month of winter (December, 2010), compared to 57 crashes in the previous winter (2009). It is therefore important to set safety standards for contractors involved in snow and ice control.

Most agencies either think that there is no difference in accident rates or they do not track accident rates when comparing in-house and contracted services.

From the survey, *65% of the survey respondents indicated that they set safety standards for the*

contractors, while 35% of the respondents indicated that they do not set any safety standards for the contractors employed during snow and ice control operations. Safety standards for the contractors employed during snow and ice control operations may include;

- Speed monitoring during plowing and material application
- Lighting requirement for winter maintenance vehicles
- Mandated drug and alcohol testing
- Commercial Driver License
- Guidance on treating bridges

When asked about accident rates between contracted versus in-house services, most of the respondents either think that there is no difference in accident rates or they do not track accident rates between these two groups. In particular, one agency reported that an increase in collisions with plow trucks is attributed to an increase in traffic volume and speed (driving faster than past years). In contrast, another respondent mentioned there is a greater chance of accidents with the use of contracted services, but did not provide data to prove this. *None of the responding agencies reported a decrease in accident rates with the use of contracted services.* Of the agencies responding to the survey, 70% indicated that contractors are responsible for any damage (life and property) during snow and ice control. In some cases, the state agency pays for damages if the local agency is contracted, as long as the contractor does not disregard safety regulations.

4.5 Emergency Management

Winter maintenance agencies may infrequently encounter extraordinary winter storms that greatly exceed their capabilities regardless of whether they rely upon contracted services only or on a combination of in-house and contractor services. Such a storm, or close series of storms, is of such intensity, accumulation, and duration as to overwhelm the agency's and/or contracted services' capabilities. In such instances, it is important to coordinate the emergency deployment with their existing contractors. In addition, agencies may move resources from other parts of the state to handle emergency situations. Furthermore, *an agency may call upon additional contractors with extra or special capabilities who normally are not involved in snow removal.* For example, a major highway contractor with road graders, large front loaders, and skid steers not used during the non-construction season may be pressed into service. If snow needs to be hauled away from congested areas, *such as a downtown, the contractor's dump trucks and dump trailers will be needed. The recovery effort after the massive snow storms that buried the Boston, Massachusetts area in early 2015 is a classic example of how construction companies with such equipment were used along with Mutual Aid resources from other jurisdictions (New York City sent a snow melting unit).* Also, ice storms are very destructive and produce huge amounts of roadway debris from downed trees and branches. For removing this debris, agencies may need to hire contractors with specialized equipment such as grapple trucks.

Agencies tend not to pay additional cost for long-term contractors involved in emergency deployments. Local agencies and short-term contractors may get "additional cost paid" and/or "shared resources."

It is also important for agencies to include how the cost will be shared with contracted services during the extra-ordinary winter circumstances. From the survey responses, about 32% of the respondents indicated that it is the responsibility of contractors to deploy additional resources during emergency deployment, with the additional cost reimbursed to the contractor during emergency deployment. By contrast, about 26% of the respondents indicated that it is the responsibility of contractors to deploy additional resources and bear the additional cost. Most of the agencies under this category tend to have long-term contracts (5 years or more) and agencies consider that costs eventually balance out over a long period of time. Another 16% of the respondents indicated that the agency provides additional resources (labor and equipment) from other parts of the state to contractors. These respondents indicated they mostly hire local agencies or short-term contractors to carry out the winter maintenance activities. Finally, 26% of the respondents indicated emergency deployments are not required to be handled by contracted forces. In situations where contractors are not responsible for emergency deployments, 30% of the respondents indicated that the agency recruits additional contractors only for emergency deployments and 20% of the respondents indicated that the agency uses its own resources to coordinate emergency deployments. However, none of the responding agencies provided additional short term subcontracts to address the added cost. One respondent indicated that the agency brings resources from unaffected districts for support during emergency deployments.

It is likely that such extraordinary storm events could qualify for state and/or federal disaster assistance in the form of reimbursement costs. However, the contracting process must comply with stringent requirements and rules governing procurement, documentation, and payment. That aside, it is recommended that prior to each winter season an agency project the likelihood of an extreme storm, determine what effect it would have, and assess its capabilities to adequately combat it. After identifying gaps in resources, the agency next identifies sources of additional resources. The construction companies that an agency routinely uses for building and maintaining roads should be readily available. Some of those companies may not want to be involved in snow or debris removal or fully understand when they might be needed and what they will do, which is why it is important to discuss such work with them well in advance. If they are interested, then requirements and rates need to be negotiated and a formal agreement or contract established in accordance with both agency policies and Federal Emergency Management Agency (FEMA) guidelines. Without pre-existing contracts, an agency will encounter delays in obtaining the needed assistance and likely will be paying a lot more for the work. Though FEMA allows for emergency contracting for the first 70 hours of a presidential declared disaster, contracts must meet the exacting FEMA standards following this 70 hour period.

When agencies develop contracts they should comply with the rules and requirements governing procurement, documentation, and payment in order to aid in receiving federal disaster assistance.

4.6 Incentives and Disincentives in Contracting

While incentive payments for performance in winter maintenance are common across the globe, few State DOTs have adopted a variety of incentive and disincentives to encourage performance and encourage contractors to maintain modern technology and practices. In states with incentive opportunities, most are for equipment purchases, equipment financing arrangements, or training

and certifications. Other incentives based on performance of actual snow removal practices are encouraged, but not widespread in contract language. This section explores these incentive programs and provides information on some limited additional unique program activities.

About 20% of survey respondents indicated that their agency provides incentives to encourage the use of advanced technologies – conversely 80% of agencies do not. *Common incentives provided by the responding agencies included an increase in pay rate or bonuses.* In some cases, advanced technologies are mandated as a part of the contract or agencies provide the advanced technologies. As an example, Massachusetts DOT (MassDOT) encourages contractors to update their fleet of equipment with modern winter maintenance application equipment through the use of financial incentives (Fay et al., 2013). MassDOT encouraged winter maintenance contractors to invest in newer closed loop spreader technology by offering an additional \$16 per hour per retrofitted truck, if done in the first three years of the request. After the three year period, all contractors were required to have this technology onboard material application trucks and the incentive program ended. The amount of the incentive was calculated based on the cost-savings related to the use of the new technology. Rhode Island, starting in 2012, offered incentives for vendors that included GPS and wireless technologies on their spreader equipment. Rhode Island is also considering financing and rebate options to encourage additional use of the technology.

In general incentives and disincentives are not commonly used with contracted snow and ice response.

Performance Based Management Contracts (PBMC) also include incentives, however only 16% of respondents currently use these performance based contracts. NCHRP synthesis 389 stated “*The hallmark of PBMC is to pay a contractor based on the results achieved, not on the methods for performing the work*” (Hyman, 2009). The study also highlighted the need for a balanced approach, including both incentives and disincentives or other penalties. Transportation agencies do not have many options when contractors fail to adequately provide snow and ice control. The District of Columbia uses incentive payments on its National Highway System snow and ice control contracts. In this instance performance increased by over 300% on overall highway ratings (Hyman, 2009).

Common incentives based on performance include accelerated payments or bonuses for using certain types of technology in practice. Some states offer percentage bonuses for committing to the program early in the season (e.g., submitting all necessary contract documentation by October in advance of the snow removal season). *The most common measures for calculating performance incentives include material usage, duration to bare pavement, and operating speed recovery from the end of storm events.* No current incentives are used in operating speed recovery, however incentives for material usage reductions and time to achieve bare pavement after storm events subside are used. Past studies in Ontario showed that contractors under performance based contracts used less equipment, resulting in longer times to achieve bare pavements.

Incentives used include increases in pay rates or bonuses, while disincentives used may include termination of contracts.

Minnesota DOT has piloted a program to encourage landowners to leave standing rows of corn in problem areas to serve as a living snow fences. These incentive payments help reduce the need for snow removal services by preventing blowing and drifting snow.

To encourage an increased number of plow drivers, states including Vermont, California, Massachusetts, and Wyoming have increased pay to snow plow drivers. In Massachusetts, snow plow removal services compete with municipal and private companies, necessitating the increased pay rate.

States have also adopted penalties in their contract maintenance efforts, generally with respect to material usage. MassDOT requires properly calibrated gate door openings on salt spreaders. Contractors in violation are removed immediately from service and financial penalties ensue.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

The following general conclusions can be made on the use of contracted services for snow and ice control based on the literature review, survey, and synthesis of information:

- Much of the available information on contracted services is provided in the context of general maintenance, and only rarely specifically addresses contracted services for winter maintenance operations.
- The main reasons for agencies to seek contractors for snow and ice response include: 1) lack of resources, 2) a state-level movement toward outsourcing or privatization, and 3) cost comparisons.
- In general, winter maintenance agencies use four types of contracting methods for snow and ice response: 1) rental agreements or short-term contracts, 2) defined amount of work or recurring work contracts, 3) blended forces and 4) asset management and public-private partnership contracts.
- Performance-Based Maintenance Contracts (PBMC) are increasingly popular in the United States and Canada. In PBMC, winter maintenance agencies usually set a minimum Level of Service (LOS) and response time to measure the performance.
- In most cases, winter maintenance agencies tend to rely on contractors to provide their own snow and ice equipment. Conversely, snow and ice control material (salt, sand, etc.) are commonly provided by the winter maintenance agencies.
- Studies have shown the need for minimum standards for the equipment used by contractors such as replacement time of aging equipment and upgrading to new technologies.
- It is generally perceived that urbanized areas, which have a higher density of contracting firms, are a more favorable environment to use contractors for snow and ice control functions. However, contractors are willing to work in remote areas if the size and duration of contracts are large enough.
- Without definitive conclusions, it is generally perceived that contracting potentially reduces the cost for highway maintenance operations. However, the benefits of using in-house versus contracted services may be more qualitative than quantitative.
- Evidence of contracting resulting in improved LOS is inconclusive. Studies reported contractors either have improved LOS compared to in-house or provide the same LOS as in-house. However, there is a high chance of decreased performance in the first few years of contracting.
- Winter maintenance agencies have quality control measures to ensure that contractors are providing the best possible LOS for the public. This has been achieved through well-defined goals and objectives for contractors.
- In some cases, winter maintenance agencies either penalized the contractors, terminated the contractors, or reverted to in-house service if poor performance by contractors occurred.

The following general observations and recommendations were made as a result of the synthesis of this information;

- When contracting for snow and ice response, contract language should address the responsibility of equipment calibration, how often equipment should be calibrated, and

who is responsible for the calibration. This is one area where large improvements could be achieved in accuracy of applications.

- To ensure the highest level of snow and ice response, the contracting agency should consider including minimum pre-qualifications for a contract, and annual training for contracted staff.
- Available cost data related to use of contracted services for snow and ice response is inconclusive, therefore we recommend cost data be collected and compared between the use of in-house services and contractors. There is a need to compare costs on even terms, specifically similar LOS expectations.
- There appears to be a lack of available data on safety and performance of contracted snow and ice response as compared to the use of in-house resources, therefore we recommend conducting a safety study to compare crashes and accident rates between in-house and contracted service staff.
- It is recommended that agencies that use contracted services for snow and ice response consider requiring all contracts comply with FEMA guidelines in the event these services are necessary in an emergency situation.
- Incentives and disincentives appear to be commonly used with contracted snow and ice response. Some transportation agencies have had positive results from the use of incentive programs, and have been able to eliminate poorly performing contractors with disincentive programs.
- In the event of a contractor failing to perform as is outlined in the contract, the contracting agency may need to respond and for this reason maintain some states forces.

REFERENCES

- American Association of State Highway Transportation Officials. (2002) A Guide for Methods and Procedures in Contract Maintenance. AASHTO, Washington, D.C.
- Bourdon, R. (2001) Best Practices of Outsourcing Winter Maintenance Services. VMS, Inc. Richmond, VA.
- Bucyk, N., Moh L. (2005) "The evolution of highway maintenance outsourcing in Alberta." Presentation, Presented at the Annual Conference of the Transportation Association of Canada. Calgary, Alberta.
- Duncan, G., et al. (2014) Leading Practices in Large-Scale Outsourcing and Privatization of Maintenance Functions. National Cooperative Highway Research Program. Washington, D.C.
- Fay, L., Shi, X., Huang, J. (2013) Strategies to Mitigate the Impacts of Chloride Roadway Deicers on the Natural Environment. National Cooperative Highway Research Program Synthesis 449. Washington, D.C.
- Federal Highway Association (2016). How Do Weather Events Impact Roads? – Federal Highway Administration. (Accessed Sep. 14, 2016), http://www.ops.fhwa.dot.gov/weather/q1_roadimpact.htm
- Halcrow, Inc. and Asset Management Associates (2011). Cost and Benefit Study Associated with Outsourcing Roadway Maintenance Activities. Nevada Department of Transportation.
- Harrier, K., Dennis R. (1997). *Factors associated with privatization of winter maintenance functions at local government level. Transportation Research Record: Journal of the Transportation Research Board* 1585: 39-47.
- Holland, H. F. (2012). "Snow and Ice Control Operations Manual – Texas Department of Transportation." <http://onlinemanuals.txdot.gov/txdotmanuals/sic/outsourcing.htm>
- Hyman, W. A. (2009). Performance-based contracting for maintenance. National Cooperative Highway Research Program Synthesis 389. Washington, D.C.
- Kuemmel, D.A., Hanbali, R.M. (1992) "Accident Analysis of Ice Control Operations." Presentation, Presented at the Third International Symposium on Snow Removal and Ice Control Technology, Minneapolis, MN.
- Markow, M. J. (2014). Alternative Delivery Methods for Winter Operations. American Association of State Highway Transportation Officials and the National Cooperative Research Program, Washington, D.C.
- Mercury Associates, Inc. (2014). Snow and Ice Operations and Fleet Services Best practice Review for the City of Prince George. City of Prince George Public Works, Prince George, B.C.
- NOAA National Center for Environmental Information (NCEI). (2016) U.S. Billion-Dollar Weather and Climate Disasters. (Accessed Dec. 5, 2016), <https://www.ncdc.noaa.gov/billions/>
- Pakkala, P.A., de Jong, W.M., Äijö, J. (2007) International Overview of Innovative Contracting Practices for Roads, Tiehallinto – Finnish Road Administration, Helsinki.
- Petty, A.E. (2008) "Surface Transportation Weather and Snow Removal and Ice Control Technology." Presentation, Presented at the Fourth National TRB Conference on Surface

Transportation Weather: Seventh International Symposium on Snow Removal and Ice Control Technology, Indianapolis, Indiana.

Ribreau, N. H. (2004). Synopsis of WSDOT's Review of Highway Maintenance "outsourcing" Experience. Washington State Department of Transportation, Maintenance and Operations.

Salt Institute (2000) Cost-effective Wintertime Mobility and Safety: We Deserve It, We Can Afford It, fact sheet. Naples, FL.

Soergel, A. (2016). "Storm of the Century' Heaps Billions in Losses on Local Economies". (Accessed Sep 14, 2016), <http://www.usnews.com/news/articles/2016-01-26/storm-of-the-century-heaps-billions-in-losses-on-local-economies>.

Stowe, R., Nixon, W., Kirkland, K. (2007) Highway Maintenance Outsourcing: An Update to the 2004 Report. Washington State Department of Transportation.

Virginia Department of Transportation (2006) Annual Report on Initiatives for Outsourcing, Privatization and Downsizing within VDOT. Richmond, VA.

Virginia Department of Transportation (2015) Annual Report 2015. Virginia DOT. Richmond, VA.

Warne, T. R. (2003). State DOT outsourcing and private-sector utilization. Transportation Research Board, National Cooperative Research Program. Washington, D.C.

Wiegmann, J., Sundararajan, A., Tao. Z. (2011) Decision Making for Outsourcing and Privatization of Vehicle and Equipment Fleet Maintenance. National Cooperative Highway Research Program, Transportation Research Board. Washington, D.C.

Wilson, B. (1999). *Look at what they can do*. Roads & Bridges Volume: 37 Issue Number: 12 Publisher: Scranton Gillette Communications ISSN: 8750-9229 OCLC: 11660022

APPENDIX A
Survey Questionnaire



North American Contracting for Snow and Ice Response

Introduction

The Western Transportation Institute (WTI) at Montana State University is conducting this survey for a research project for Clear Roads and the Minnesota Department of Transportation. The purpose of this survey is to gather information from winter maintenance supervisors and managers on their experience with contracting snow and ice control operations.

For the purposes of this survey, contracting snow and ice control operations refers to private/commercial contractors or local agency contractors.

This survey is estimated to take about 15 - 20 minutes to complete.

- Participation is voluntary.
- You can choose to not answer any question, and you can stop at any time.
- Your contact information will only be used by the researchers for the purposes of this study.
- We may try to contact you for clarification or additional information.

- Your participation in any follow up phone calls or emails is also voluntary.

If you have any questions about the survey, please contact Anburaj Muthumani at anburaj.muthumani@montana.edu or call (406) 994-6782.

Your knowledge and experience are key, so we really appreciate your participation!



North American Contracting for Snow and Ice Response

Background Information

1. Survey Respondent Information

Name

Title

Agency Name

E-mail

Phone

2. Agency Type

State/Province Department of Transportation (DOT)

County Public Works/DOT

Municipal Public Works

Federal

Toll Authority/Special District

Tribal/Territorial

Other (please specify)

3. Please provide the total lane-miles/kilometers currently maintained by your agency.

4. Please provide the total snow and ice lane-miles/kilometers maintained by your agency

* 5. Does your agency use contracted services for snow and ice control operations? *Please note that this survey is capturing information relevant to contracted services only for snow and ice control operations*

- Yes (Private/commercial contractor)
- Yes (Local public agency - Contracts given to counties, municipalities, etc.,)
- Yes (Both Private/Local Public Agency)
- No

If **No**, please provide your reasons for not contracting snow and ice control operations



North American Contracting for Snow and Ice Response

Reason and type of contracting

6. What are the primary reasons for your agency to use contracted services for snow and ice control operations? Choose all that apply.

- Lack of agency resources - caps on labor
- Lack of agency resources - equipment fleet
- A state-level movement toward privatization (legislative action)
- Added lane mileage
- Effort to reduce cost using contracted services
- Difficulty in retaining & replacing skilled workers
- Difficulty in obtaining, retaining & maintaining snow and ice control equipment
- Proximity of resources to snow and ice control service area (e.g. excessive distance from in-house resources)
- Other (please explain)

7. How long your agency is using contracted services for snow and ice control operations?

- 0-1 year
- 1-3 years
- 3-5 years
- 5-10 years
- 10-15 years
- 15-20 years
- Above 20 years

8. Please select the type of contracting methods used by your agency for snow and ice control operations. Choose all that apply.

- Agreements for equipment and operator (during normal winter circumstances)
- Agreements for equipment and operator (only during extraordinary circumstances)
- Short term contracts (1 to 3 years)
- Long term contracts (up to 5 years or more)
- Defined amount of work (for a particular road segment)
- Performance based contracts
- Blended forces (in-house and contracted services working together)
- Public-Private partnership derived contracts
- Time and Materials; Labor, Materials and Equipment) w/Guaranteed minimum payment (e.g. portion of contract value)
- Indexed Lump Sum; Contract paid per lane mile for estimated expenditures with adjustments for change in scope of work (harsher or mild winters) w/Guaranteed minimum payment (e.g. portion of contract value)
- Fixed Lump Sum; Fixed Annual Payment of Estimated expenditures regardless of winter severity.
- Limited services (after storm clean-up, parking lane clearing, hauling snow, etc)
- Other (please explain)

9. How does your agency design or establish contracts for snow and ice control operations?

- Separate winter activities contract only
- Combined with year-round maintenance contracts
- Other (please specify)

10. If it is a year-round maintenance contract, please indicate the primary business of your contractor(s):

- Construction/concrete delivery
- Road maintenance
- Landscaping/tree service
- General hauling
- Solid-waste disposal
- Snow and ice control (operates only during the winter season)

Other (please specify)

11. In your best estimate, what percentage of lane-miles/kilometers is being contracted by your agency for snow and ice control operations?

	Private/commercial contractor	Local Public Agency
0 to 10%	<input type="checkbox"/>	<input type="checkbox"/>
10 to 20%	<input type="checkbox"/>	<input type="checkbox"/>
20 to 30%	<input type="checkbox"/>	<input type="checkbox"/>
30 to 40%	<input type="checkbox"/>	<input type="checkbox"/>
40 to 50%	<input type="checkbox"/>	<input type="checkbox"/>
50 to 75%	<input type="checkbox"/>	<input type="checkbox"/>
75% or more	<input type="checkbox"/>	<input type="checkbox"/>

Other (please specify)



North American Contracting for Snow and Ice Response

Qualification and Training

12. Are snow and ice control contractors pre-qualified? *Pre-qualified refers to contractors meeting requirements set by your agency in finance, staff, equipment, length of business experience, insurance, etc.*

Yes

No

If yes, please explain. If available considering sharing any documentation on this topic your agency uses as guidelines. [Upload here](#) or email to anburaj.muthumani@montana.edu

13. Do you require the contractors' personnel to have a certain degree of experience and/or approved training in snow and ice control before awarding the contract?

Yes

No

If yes, please comment on the requirements

14. Does your agency require any additional training for contractors' personnel after the contract is awarded?

Yes (Paid for training time)

Yes (Not paid for training time)

No

15. If there is a training/certification program, how often is recertification required?

- 1 year
- 2 years
- Never
- Other (please specify)



North American Contracting for Snow and Ice Response

Geographic Location

* 16. Where does your agency predominantly use contracting services?

- Urban areas only (Includes arterials streets, collectors streets, parking lots, etc.,)
- Rural areas only (Includes major highways, low volume roads, etc.,)
- Both urban and rural



North American Contracting for Snow and Ice Response

Geographic Location - Urban

17. Please select the **predominant road type** in urban areas where your agency use contracted services. Choose all that apply.

- Any street classification
- Arterials
- Arterials and collectors
- Residential streets
- Cul-de-sacs
- Parking lots
- Other (please specify)

18. Do you have any difficulty in finding contractors in "urban areas" for snow and ice control?

- Yes (Lack of resources and/or contractors)
- No (I have multiple contractors to select)

Other (please specify)



North American Contracting for Snow and Ice Response

Geographic Location - Rural

19. Please select the **predominant road type** in rural areas where your agency use contracted services. Choose all that apply.

- Any road classification
- Major roads/highways only
- Low-volume roads only
- Other (please specify)

20. Do you have any difficulty in finding contractors in "rural areas" for snow and ice control?

- Yes (Lack of resources and/or contractors)
- No (I have multiple contractors to select)

Other (please specify)



North American Contracting for Snow and Ice Response

Geographic Location - Urban and Rural

21. Please select the **predominant road type** in urban and rural areas where your agency use contracted services. Choose all that apply.

- Any street classification
- Arterials only
- Arterials and collectors only
- Residential streets only
- Cul-de-sacs only
- Parking lots only
- Any road classification
- Major roads/highways only
- Low-volume roads only
- Other (please specify)

22. Do you have any difficulty in finding contractors in "urban areas" for snow and ice control?

- Yes (Lack of resources and/or contractors)
- No (I have multiple contractors to select)

Other (please specify)

23. Do you have any difficulty in finding contractors in "rural areas" for snow and ice control?

- Yes (Lack of resources and/or contractors)
- No (I have multiple contractors to select)

Other (please specify)

24. Do you have any difficulty in finding contractors in rural areas compared to urban areas for snow and ice response?

- Yes (Lack of resources and/or contractors in rural areas)
- No (I have a single contractor for both rural and urban areas)
- No (I have a different contractor specifically located in the respective rural area(s))

Other (please specify)



North American Contracting for Snow and Ice Response

Equipment, snow and ice control materials and training

25. For the contracted winter maintenance work, who provides the equipment (snow plows, spreaders, etc.)?

- Contractor only
- Agency only
- Both contractor and agency
- Other (please specify)

26. If the contractor provides the equipment, who is responsible for equipment calibration (e.g., spreader)?

- The contractor
- The agency
- No calibration required

27. Does your agency require that the contractor's equipment be maintained to meet specific standards?

Yes

No

If yes, please explain

28. Does your agency provide incentives to encourage the use of advanced technologies? (GPS/AVL, closed loop spreaders, etc.)

Yes

No

If yes, please explain. Consider sharing documentation used by [uploading here](#) or email anburaj.muthumani@montana.edu

29. Who provides the snow and ice control materials (salt, sand, liquid chemicals, etc.) for contractors?

Contractor only

Agency only

Both contractor and agency

Other (please specify)



North American Contracting for Snow and Ice Response

Cost, performance, and level of service

30. Do you use "Performance Based Contracting Method (PBMC)" for snow and ice control operations? PBMC is a contracting method that provides incentives and/or disincentives to the contractor to achieve desired outcomes or results.

- Currently in use
- Previously used
- Never used and have plans to implement in the future
- Never used and have no plans to implement in the future
- Other (please specify)

31. Do you have a formal "quality control measures" and/or "performance standards" for your in-house staff?

- Yes
- No

If yes, please comment below. Consider sharing this documentation by [uploading it here](#) or email to anburaj.muthumani@montana.edu

32. Do you require the submission of an "Operational Plan" from the contractor?*An Operational plan is submitted if the local agency (counties/municipalities) contracts the snow and ice response. An Operational plan identifies the work limits, expectations, time to respond and any extra work (snow fences, parking lanes, etc). required by the local agency during the contract.*

- Yes
- No

If yes, please comment below. Consider sharing this documentation by [uploading it here](#) or email to anburaj.muthumani@montana.edu

33. Do you monitor contractor's Material Application Rates? (Check all that apply)

- Guidance application rates are provided to the contractor
- Specific application rates for given situations are provided to the contractor
- Application rates are monitored as a part of the contract
- Contractor determines application rates
- Contract is responsible for tracking application rates
- Applications rates are not provided
- Application rates are not tracked
- Others (please specify). Consider sharing any documentation by [uploading it here](#) or email to anburaj.muthumani@montana.edu

34. How do you set performance standards for contracting services used in snow and ice response?

- Use same standards as in-house staff
- Compare performance with other similar agencies
- Set stretch goals (Initial agreeable targets and increase targets based on technological changes)
- None
- Other (please specify)

35. Do you use any of the following “quality control measures” to measure the performance of contractors employed during snow and ice control operations? Please choose all that apply

- Specified time periods to respond for a winter event
- Achieve specified friction levels
- Prior forecasting and anti-icing
- Need to remove snow and/or ice (at a minimum) from travel lanes, turn lanes, intersections, shoulders and interchanges, enforcement areas, and police parking locations prior to the end of the winter event
- Highways clear within certain time after end of winter event
- None

Other (please specify)

36. How would you compare contracted services to the in-house services for snow and ice response?

- Improved Level of Service (LOS) compared to in-house services
- Same LOS as in-house services
- Decreased LOS compared to in-house services
- Decreased LOS in the first few years (mostly two years) of contract and then improved Level of Service over time
- Other (please specify)

37. Does your agencies provide any incentives/disincentives based on the performance of the contractors used in snow and ice response?

- Yes
- No

If yes, please explain

38. In your opinion, is there any significant cost differences between contracted services and in-house services?

- Decrease in cost due to contracted services
- Increase in cost due to contracted services
- No difference in cost between contracted services and in-house staff
- Other (please specify)

39. Did you perform any formal cost-benefit analysis between contracted services and in-house services?

- Yes
- No

If yes, please consider sharing by [uploading it here](#) or email to anburaj.muthumani@montana.edu



North American Contracting for Snow and Ice Response

Emergency deployments

40. During emergency deployments (during extreme weather conditions - snow events, flooding, etc.), how do you coordinate with contracting services?

- Agency provides additional resources (labor and equipment) from other parts of the state to contractors (no cost sharing – only resources shared)
- It is the responsibility of contractors to deploy additional resources and bear the additional cost
- It is the responsibility of contractors to deploy additional resources at additional cost paid to the contractor
- Emergency deployments are not required by contracted forces

Other (please explain)



North American Contracting for Snow and Ice Response

Emergency deployments 2

41. If contractors are not responsible for emergency deployments how does your agency address the need for additional resources during extreme winter events?

- Our agency provides additional short term subcontracts to address the added cost
- Our agency uses their own resources to coordinate emergency deployments
- Our agency recruits additional contractors only for emergency deployments
- Other (please specify)



North American Contracting for Snow and Ice Response

Safety

42. Do you set any safety standards for the contractors employed during snow and ice response?

Examples: speed limit for snow plows, mandated drug and alcohol testing, etc?

Yes

No

If yes, please explain. Consider sharing these guidelines by [uploading it here](#) or email to anburaj.muthumani@montana.edu

43. Are there any differences in the operator accident rates or damage to equipment for contracted vs. in-house forces operating in similar conditions or similar area?

Decrease in accident rates/damage to equipment with the use of contracted services

Increase in accident rates/damage to equipment with the use of contracted services

No difference in accident rates/damage to equipment between contracted services and in-house staff

We do not track accident rates of contractors

Other (please specify)

44. Are contractors required to be responsible for any damage (life and property) during snow and ice control?

Yes

No

Other (please specify)



Issues with contracted services

45. Has your agency reverted (from contracted forces back to state forces) to using agency resources instead of contracted services?

- Yes, completely
- Yes, partially
- No

If yes, please explain why, how, costs, etc.

46. Has your agency had to terminate a contract for any reason within the last 5 years?

- Yes
- No

If yes, please briefly explain the reason

47. Have you had any contractors terminate contracts for any reason?

- Yes
- No

If yes, Please explain

48. Are there any specific lessons learned when contracting snow and ice operations? Please explain.



North American Contracting for Snow and Ice Response

Thank you - Survey Complete

Thank you for your participation. Please visit the Clear Roads website (www.clearroads.org) for information on this project and to find project deliverables.

APPENDIX B

Detailed Survey Responses

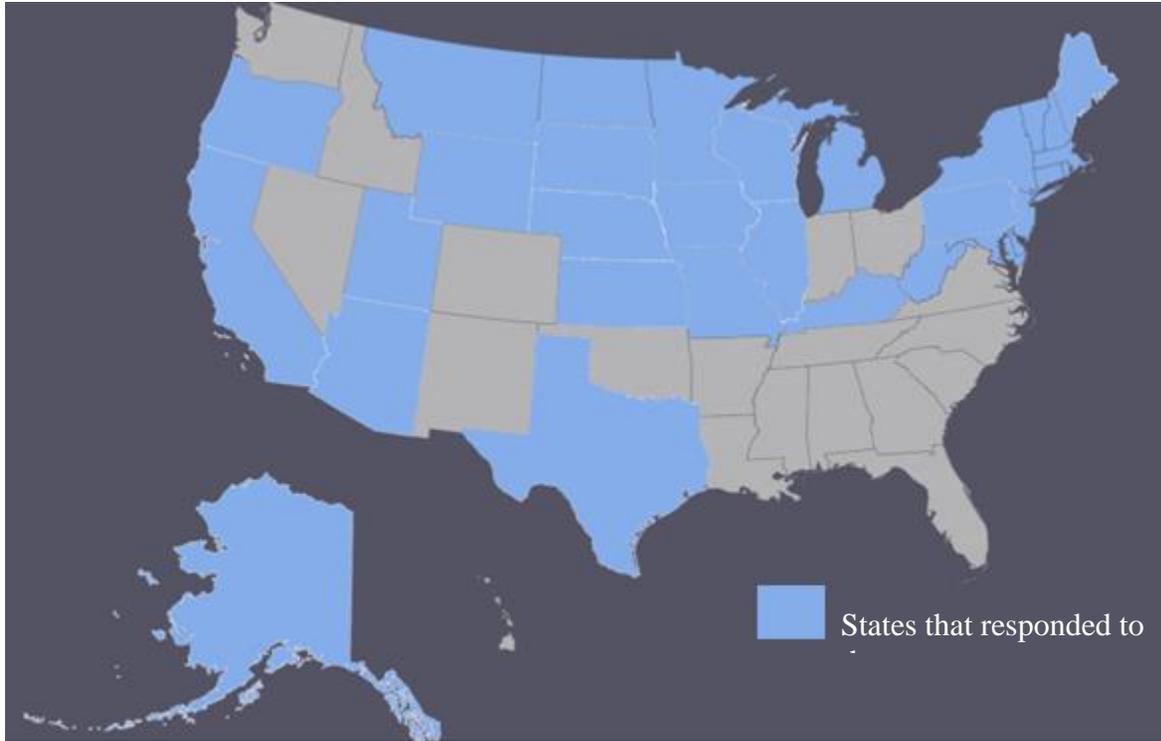
Q1 and Q2: Survey Respondent Information

Survey responses were from state/province DOT (87.2%), county Public Works/DOT (4.3%) and municipal public works (6.4%). Other responding groups include a private maintenance contractor. Specific response count and response percent for each group are presented in Table 1. A total of 51 respondents participated in the survey, from 31 states within the U.S and three provinces from Canada (Alberta, Ontario and British Columbia) as shown in Figure 1.

Table 1: Number of responses for each group

Answer Options	Response Percent	Response Count
State/Province DOT	87.2%	41/46
County Public Works/DOT	4.3%	2/46
Municipal Public Works	6.4%	3/46
Federal	-	-
Toll Authority/Special District	-	-
Tribal/Territorial	-	-
Others*	2.1%	1/46
<i>answered question</i>		46

* Includes responses from private maintenance contractors



Canada Provinces that responded to the survey: Alberta, Ontario and British Columbia

Figure 1: States that responded to the survey

Q3 and Q4: Please provide the total lane-miles/kilometers and total snow and ice lane-miles/kilometers currently maintained by your agency.

There were 42 responses for this question. The total lane-miles and total snow and ice lane-miles maintained by responding agencies ranges from 800 to 77,000 lane-miles.

Q5: Does your agency use contracted services for snow and ice control operations?

There were 51 responses for this question.

Table 2 shows the responses for agency use of contracted services for snow and ice control operations. About 60% of respondents indicated they use contracted services and 40% indicated they do not use contracted services for snow and ice response. The majority of respondents who use contracted services hire private or commercial contractors for snow and ice response. Very few respondents (2 respondents) indicated using local public agencies only or both private and local public agency for snow and ice response.

Table 2: Agencies responses for agency use of contracted services for snow and ice control operations.

Answer Options	Response Percent	Response Count
Yes (Private/commercial contractor)	45.1%	23/52
Yes (Local public agency - Contracts given to counties, municipalities, etc.,)	11.8%	6/52
Yes (Both Private/Local Public Agency)	3.9%	2/52
No	39.2%	20/52

Respondents provided various reasons for not contracting snow and ice control operations including:

- Increased cost
- Response time variations
- Reduced level of service
- Non-availability of contractors
- Non-availability of specialized equipment and labor from contractors
- Surplus and efficient in-house staff
- Agencies contracting system is limited.

Additionally, agencies mentioned using contracted services only during emergency situations.

Reasons and type of contracting

Q6: What are the primary reasons for your agency to use contracted services for snow and ice control operations? Choose all that apply.

There were 51 responses for this question.

Table 3 shows the primary reasons for the agency to use contracted services for snow and ice control operations. About 50% of the respondents indicated that lack of agency resources (caps on labor and equipment) was the main reason for using contracted services. About 25% indicated that

state-level movement toward privatization (legislative action) and efforts to reduce cost using contracted services were the reasons for using contracted services. Another 20% indicated difficulty in retaining & replacing skilled workers and 16% indicated added lane mileage as the reasons for using contracted services. Respondents provided additional reasons for using contracted services listed below.

- Privatization implemented for highway maintenance.
- If state highways go through a city, agencies contract with the city to conduct snow removal operations.
- During extreme winters (limited contracting only)
- To meet the level of service (12-hour completion time)
- Limited use for snow and ice control equipment during the summer months.

Table 3: Primary reasons for the agency to use contracted services for snow and ice control operations.

Answer Options	Response Percent	Response Count
Lack of agency resources - caps on labor	48.0%	12/25
Lack of agency resources - equipment fleet	48.0%	12/25
A state-level movement toward privatization (legislative action)	24.0%	6/25
Added lane mileage	16.0%	4/25
Effort to reduce cost using contracted services	24.0%	6/25
Difficulty in retaining & replacing skilled workers	20.0%	5/25
Difficulty in obtaining, retaining & maintaining snow and ice control equipment	8.0%	2/25
Proximity of resources to snow and ice control service area (e.g. excessive distance from in-house resources)	8.0%	2/25

Q7: How long has your agency used contracted services for snow and ice control operations?

There were 24 responses for this question. The majority of the respondents (about 90%) have been using contracted services for 15 years or more for snow and ice control. Very few respondents (about 10%) indicated using contracting services for about 3 to 10 years for snow and ice control.

Q8: Please select the type of contracting methods used by your agency for snow and ice control operations. Choose all that apply.

There were 25 responses for this question.

Table 4 shows the contracting methods used by the agency for snow and ice control operations. About half of the respondents indicated contracting includes agreements for equipment and operator (during normal winter circumstances) and long term contracts (up to 5 years or more). Additionally, about one-third of the respondents use short term contracts (1 to 3 years), fixed lump sum (fixed annual payment of estimated expenditures regardless of winter severity) contracts and blended forces contracts (in-house and contracted services working together) for snow and ice control. Another 20% of the respondents use agreements for equipment and operator (only during extraordinary circumstances), defined amount of work (for a particular road segment) and time and materials with guaranteed minimum payment contracts (e.g., portion of contract value) for snow and ice control. Very few respondents (16%) indicated using performance based contracts, limited services (after storm clean-up, parking lane clearing, hauling snow, etc.), and public-private partnership derived contracts. Less than 10% of the respondents indicated using indexed lump sum contracts, or contracts paid per lane mile for estimated expenditures with adjustments for change in scope of work (harsher or mild winters) with guaranteed minimum payment (such as a portion of the contract value). In addition, respondents provided other contracting methods listed below.

- Local agencies receive indexed payments.
- Contractors are generally paid hourly rates with some having guaranteed minimums.
- Contracts are hourly based for labor and equipment, but there is a guaranteed minimum for 6 lowest bidders of the 20 contracted as a means to entice lower bids.

- Equipment with driver, w/ guaranteed minimum payment.
- Retrofit cost to provide a truck complete with a plow, spreader, liquid system, communications system. Others are a sealed bid item.
- Actual cost for equipment, materials, and manpower (No profit – Local agency).

Table 4: Contracting methods used by the agency for snow and ice control operations.

Answer Options	Response Percent	Response Count
Agreements for equipment and operator (during normal winter circumstances)	48.0%	12/25
Long term contracts (up to 5 years or more)	44.0%	11/25
Short term contracts (1 to 3 years)	36.0%	9/25
Fixed Lump Sum; Fixed Annual Payment of Estimated expenditures regardless of winter severity.	36.0%	9/25
Blended forces (in-house and contracted services working together)	32.0%	8/25
Agreements for equipment and operator (only during extraordinary circumstances)	20.0%	5/25
Defined amount of work (for a particular road segment)	20.0%	5/25

Time and Materials; Labor, Materials and Equipment) w/Guaranteed minimum payment (e.g., portion of contract value)	20.0%	5/25
Performance based contracts	16.0%	4/25
Limited services (after storm clean-up, parking lane clearing, hauling snow, etc.)	16.0%	4/25
Public-Private partnership derived contracts	12.0%	3/25
Indexed Lump Sum; Contract paid per lane mile for estimated expenditures with adjustments for change in scope of work (harsher or mild winters) w/ Guaranteed minimum payment (e.g., portion of contract value)	8.0%	2/25

Q9: How does your agency design or establish contracts for snow and ice control operations?

There were 24 responses for this question. Table 5 shows the agencies’ methods to establish contracts for snow and ice control operations. About 65% of the respondents indicated establishing a separate winter activities contract for snow and ice control operations. However, 25% of the respondents indicated combining winter maintenance contracts with year-round maintenance contracts. Other types of contracts provided by respondents included hourly contracts and winter or emergency contracts. One agency indicated giving the option to the local agency to choose between year-round and winter contracts only.

Table 5: Agencies’ methods to establish contracts for snow and ice control operations

Answer Options	Response Percent	Response Count
Separate winter activities contract only	62.5%	15/25
Combined with year-round maintenance contracts	25.0%	6/25
Other (please specify)*	16.6%	3/25

**includes hourly contracts, winter or emergencies, and choice given to local agency (year-round vs winter only).*

Q10: If it is a year-round maintenance contract, please indicate the primary business of your contractor(s).

There were 11 responses for this question. The majority of the respondents (72.7%) indicated that the primary business of the contractors is road maintenance. However, a few respondents (36.4%) stated that the primary business of the contractors is Construction/concrete delivery. One respondent indicated that the primary business of the contractor is landscaping/tree service.

Q11: In your best estimate, what percentage of lane-miles/kilometers is being contracted by your agency for snow and ice control operations?

There were 22 responses for this question. In general, the majority of respondents contract either 75% or more of snow lane-miles to contractors (Private/commercial contractor and Local Public Agency) or 10 – 20% of snow lane-miles to the contractors. In other words, respondents indicated either contracting all the snow and ice roads to contractors or only few selected snow and ice roads to contractors.

Qualification and Training

Q12: Are snow and ice control contractors pre-qualified? Pre-qualified refers to contractors meeting requirements set by your agency in finance, staff, equipment, length of business experience, insurance, etc.

There were 24 responses for this question. About 58% of the respondents mentioned that their contractors are pre-qualified and 42% of the respondents mentioned that their contractors are not pre-qualified. Below responses are provided by each respondent on the qualification criteria.

- Three-tiered system.
 - Tier one: Contractor demonstrating sufficient insurance and bonding. Result will be pass or fail. Contractor has to pass to advance to next tier.
 - Tier two: Service proposal demonstrating the approach to the work (number of plows, number of staff, where the yards will be located etc.). Service proposal is worth 30% of the final score (out of 100). Contractor must get a minimum of 15 points to continue to advance to next tier.
 - Tier three: Based on the cost quoted. Cost proposal is worth 70 of the final score (out of 100).
 - Contractor with the most points will be successful proponent.

- Pre-qualify contractors in terms of insurance requirements, but not local agencies.
- Municipal contractors are "qualified" and must meet NYSDOT guidelines for S&I control.
- Financial prequalification followed by technical evaluation.
- Specific insurance coverages, DOT certs, equipment inspections, time frame deadlines for submittals, etc.
- Contractor trucks are inspected, and insurance and any truck violations are verified
- Potential bidders are pre-qualified through Transportation Purchases Office.
- Lowest bid price
- The contract we have is very detailed to its requirements of the DOT
- Must have performed a similar type of work and provide references

Q13: Do you require the contractors' personnel to have a certain degree of experience and/or approved training in snow and ice control before awarding the contract?

There were 24 responses for this question. About 52% of the respondents indicated that their contractors' personnel need experience and/or approved training in snow and ice control. Another 48% of the respondents indicated that their contractors' personnel do not need experience and/or approved training in snow and ice control. Below are the response provided by each respondent on the degree of experience and/or approved training in snow and ice control for contractors' personnel.

- Contractors provide extensive training to operators.
- We train contractors with our personnel.
- We do not ask for specific training or certification, but as part of the service proposal evaluation we evaluate the contractor on their personnel's experience in maintenance and local knowledge of the service area. We also require our contractors to follow ISO

[International Standards] principles when creating their Quality Management System for demonstrating how they will do this and self-assess their work.

- In a proposal for a new contract, the prospective contractor must commit to having a work force with a minimum 75% of equipment operators having 3 years or more experience. If not, an increased training program to compensate for the less experienced personnel is required.
- Contractor certifies that staff are trained, supplemented by joint contractor-MTO [Ontario Ministry of Transportation] training.
- Contract drivers must attend a snow meeting prior to winter and watch a presentation created by our staff.
- They must be experienced operators.
- Drivers are required to have their commercial driver's license (Class B) and the department provides training prior to season.
- At minimum, two years of plowing/spreading experience for another entity.
- Yes, training is a line item in the contract.
- Commercial driver's license.

Q14: Does your agency require any additional training for contractors’ personnel after the contract is awarded?

There were 23 responses for this question. Table 6 shows the agencies requirement for any additional training for contractors’ personnel after the contract is awarded. More than 50% of respondents indicated that their contractors do not require any additional training for contractors’ personnel after the contract is awarded. However, 35% of the respondents mentioned that their contractors do need additional training and agencies pay for the training. Similarly, 13% of the respondents mentioned that their contractors do need additional training but agencies do not pay for the training.

Table 6: Agencies requirement for any additional training for contractors’ personnel after the contract is awarded

Answer Options	Response Percent	Response Count
Yes (Paid for training time)	34.8%	8/23
Yes (Not paid for training time)	13.0%	3/23
No	52.2%	12/23

Q15: If there is a training/certification program, how often is recertification required?

There were 19 responses for this question. Most respondents mentioned that training/certification program recertification is not required except for two respondents indicating training/certification program recertification is required once a year and once every two years, respectively. Additionally, respondents indicated needing annual training before winter season without any formal certification program.

Geographic location

Q16: Where does your agency predominantly use contracting services?

There were 26 responses for this question. About 65% of responding agencies use contracting services for both urban and rural locations. Another 20% of the responding agencies use contracted services only for rural areas (includes major highways, low volume roads, etc.) and the remaining 15% of the responding agencies use contracted services only for urban areas (includes arterials streets, collectors streets, parking lots, etc.).

For Q16 urban only selections

Q17 and Q18: Please select the predominant road type in urban areas where your agency uses contracted services. Do you have any difficulty in finding contractors in "urban areas" for snow and ice control?

There were three responses for this question. The predominant road type in urban areas contracted by agencies included roads of any street classification, as well as arterials, collectors, cul-de-sacs, parking lots, alleys, and state highways going through the city. Also, all three respondents indicated difficulty in finding contractors (lack of resources and/or contractors).

For Q16 rural only selections

Q19 and Q20: Please select the predominant road type in rural areas where your agency uses contracted services. Do you have any difficulty in finding contractors in "rural areas" for snow and ice control?

There were five responses for this question. The predominant road type in rural areas contracted by agencies included roads of any classification, as well as state highways, major roads/highways only, and low-volume roads only. Two respondents indicated difficulty in finding contractors (lack of resources and/or contractors) and three respondents indicated no difficulty in finding contractors (multiple contractors to select) for rural areas.

For Q16 both urban and rural selections

Q21: Please select the predominant road type in urban and rural areas where your agency uses contracted services. Choose all that apply.

There were 17 responses for this question. The majority of the respondents (10 respondents) indicated contracting major roads/highways only, followed by any road classification (6 responses) for snow and ice control operations. One respondent indicated contracting all provincial highways except for municipal, county, or regional roads.

Q22: Do you have any difficulty in finding contractors in "urban areas" for snow and ice control?

There were 14 responses for this question. Five respondents indicated difficulty in finding contractors (lack of resources and/or contractors) and nine respondents indicated no difficulty in finding contractors (multiple contractors to select) for urban areas.

Q23: Do you have any difficulty in finding contractors in "rural areas" for snow and ice control?

There were 14 responses for this question. Six respondents indicated difficulty in finding contractors (lack of resources and/or contractors) and eight respondents indicated no difficulty in finding contractors (multiple contractors to select) for rural areas.

Q24: Do you have any difficulty in finding contractors in rural areas compared to urban areas for snow and ice response?

There were 12 responses for this question. Five respondents indicated difficulty in finding contractors in rural areas (lack of resources and/or contractors) compared to urban areas. Six respondents indicated no difficulty in finding contractors in rural areas (multiple contractors to select) compared to urban areas. One respondent indicated having the same contractor for both rural and urban areas. One respondent mentioned it is more difficult to find contractors in some rural areas while others are competitive.

Equipment and Snow and ice control materials

Q25: For the contracted winter maintenance work, who provides the equipment (snow plows, spreaders, etc.)?

There were 25 responses for this question. The majority of the responding agencies (88) indicated contractors provide the equipment for the snow and ice control operations. Only 12% of respondents indicated that both the agency and contractor provide equipment for the snow and ice control operations. Interestingly, none of the respondents indicated having the agency alone providing equipment for the snow and ice control operations.

Q26: If the contractor provides the equipment, who is responsible for equipment calibration (e.g., spreader)?

There were 24 responses to this question. The majority of the responding agencies (83%) indicated that contractors are responsible for equipment calibration, except for one respondent who indicated that the agency is responsible for equipment calibration. Interestingly, 12.5% of respondents indicated that no calibration is required.

Q27: Does your agency require that the contractor's equipment be maintained to meet specific standards?

There were 25 responses to this question. The majority of the responding agencies (72%) stated that contractor's equipment needs to be maintained to meet specific standards. However, 28% of respondents indicated that equipment does not need to be maintained to meet specific standards. Below are detailed responses on the requirements of equipment specific standards.

- Equipment is inspected at government approved inspection facility every 6 months.
- Needs to function.
- State Inspection Laws.
- Provincial legislation requires regular mechanical inspections of trucks, including plow trucks, operating on public highways.
- Inspects and monitors vehicle through vehicle inspection program.
- Spreaders are calibrated to application rates desired by the State.
- Calibration and mechanical fitness.
- Require very unique and specific cutting edge attachments that they must provide and maintain.
- Equipment has to be functional throughout the season, for all call outs. Penalties are enforced for failed equipment/down time.
- Spreading equipment must show proof of calibration. Plows must be maintained at all times.
- In the contract we describe in detail what is required, if they do not meet standards they are penalized, or not paid.
- Contracts specify age, horse power, etc., of all contracted equipment. Calibration done by contractor but supervised by City staff.

Q28: Does your agency provide incentives to encourage the use of advanced technologies? (GPS/AVL, closed loop spreaders, etc.)?

There were 25 responses to this question. The majority of the responding agencies (80%) indicated that their agency does not provide incentives to encourage the use of advanced technologies, while 20% of respondents indicated that their agency does provide incentives to encourage the use of advanced technologies. Below are detailed responses on the use of incentives:

- Incentive to the contractor is greater efficiency = greater profit margin.
- [Pay a] Different rate for pre-wetting equipment.
- Our department provides AVL, RWIS, local area precision forecasts, and MDSS to contractors at no cost. (The contractors pay the hardware cost to set up AVL in their trucks.)

- Percentage of rate increase for proof and use of Closed Loop systems.
- Contractors are required to provide equipment with closed-loop controls and GPS/AVL. No incentives are provided.
- Not at this time but we are moving toward this in the near future.
- We give a per hour bonus if they provide the required equipment.
- Require contractor to utilize portable AVL boxes.
- Do not provide incentive, but all equipment such as GPS, spreader type, etc. is specified in the contract.
- It is a requirement of their contract.
- We pay for the AVL equipment.
- Technologies are encouraged but no incentives

Q29: Who provides the snow and ice control materials (salt, sand, liquid chemicals, etc.) for contractors?

There were 20 responses to this question. Table 7 shows the contract provision for delivering snow and ice control materials (salt, sand, liquid chemicals, etc.). More than half of the respondents (55%) indicated that the agency provides the snow and ice control materials, while 20% of the respondents indicated that the contractor provides the snow and ice control materials. Only one respondent indicated that both contractor and agency provide snow and ice control materials. Other information provided by agencies for delivering snow and ice control materials includes:

- Contractor provides all the ice control chemicals (liquid and solid) and we provide government gravel sources for the winter abrasive, although the contractor has to do the processing of that material to make the winter abrasive.
- Contractor provides but [the] Ministry [of Transportation] shares risk when quantities are over or under a certain amount over the season.
- WisDOT buys all the salt. The counties purchase all other materials. We reimburse them for any material they use.
- Local agencies are able to purchase salt off our statewide contracts. But they have the option to procure on their own if they desire. Local agencies are reimbursed for the amount of salt spread on truck line.

Table 7: Contract provision for delivering snow and ice control materials (salt, sand, liquid chemicals, etc.)

Answer Options	Response Percent	Response Count
Contractor only	20.0%	4/24
Agency only	55.0%	11/24
Both contractor and agency	5.0%	1/24
Other (please specify)	37.5%	4/24

Cost, Performance, and Level of Service

Q30: Do you use “Performance Based Contracting Method (PBMC)” for snow and ice control operations? PBMC is a contracting method that provides incentives and/or disincentives to the contractor to achieve desired outcomes or results.

There were 25 responses to this question.

Table 8 shows the use of PBMC for snow and ice control operations by respondents. More than half of the respondents (52%) indicated that they have never used PBMC and have no plans to implement this contract type in the future. Only 16% respondents indicated that they currently use PBMC. Similarly, 16% respondents indicated that they have never used PBMC, but have plans to implement PBMC in the future. Additional information provided by agencies regarding PBMC includes:

- There is an auditing process which does provide a bonus if basic contractual requirements are exceeded.
- Pilot projects underway to develop PBMC specifications and administration process, but several years from the final product.
- Never used but would like to implement in the future. Interested in how other states are doing this.
- We're experimenting right now with summer items like crack filling. We hope to add anti-icing someday and a PBM.

Table 8: Performance Based Contracting Method for snow and ice control operations

Answer Options	Response Percent	Response Count
Currently in use	16.0%	4/25
Previously used	0.0%	0/25
Never used and have plans to implement in the future	16.0%	4/25
Never used and have no plans to implement in the future	52.0%	13/25
Other (please specify)	16.0%	4/25

Q31: Do you have a formal “quality control measures” and/or “performance standards” for your in-house staff?

There were 25 responses to this question. Fifty percent of the respondents indicated they do have formal quality control measures and/or performance standards and fifty percent do not have formal quality control measures and/or performance standards. Information provided by the respondents on the formal quality control measures and/or performance standards is provided below.

- A quality management system is required by the contractor which includes a quality assurance supervisor.
- Have winter performance measures but not confined to in house staff as most routes are combination of hired and state.
- Staff, contractors and local agencies are required to maintain the roads to standards outlined in the Department's Maintenance Manual.
- The contractors provide QC on their work, we audit. There is an annual contractor performance assessment. This doesn't apply to in-house staff.
- Established [snow and ice] S&I control guidelines.
- All contracts have performance-based standards.
- Application rates.
- We have a snow and ice policy, along with guidelines on performing winter maintenance activities.
- We have established rates of application for materials.

- Yes, have levels of service tables by activity (salting, plowing, sidewalk, cycling) based on snow accumulation and time to complete.

Q32: Do you require the submission of an "Operational Plan" from the contractor? An Operational plan is submitted if the local agency (counties/municipalities) contracts the snow and ice response. An Operational plan identifies the work limits, expectations, time to respond and any extra work (snow fences, parking lanes, etc.) required by the local agency during the contract.

There were 23 responses to this question. About three-quarters (74%) of the respondents indicated that contractors do not need to submit an operational plan to the agency. Conversely, 26% of the respondents indicated that contractors do need to submit an operational plan to the agency. Information provided by the respondents on the operational plan required from the contractor is provided below.

- The operational plan is supported by the QMS [Quality Management System].
- The operational plan is provided during the RFP process at tender time. Requirements of this plan and how we evaluate the plan is in our contract documents on the website.
- High-level work plans are submitted as part of the contract award package (we use a Request for Proposal process to select new contractors). We do not get annual or short-term operational plans at this time, but that may be a requirement in our next round of contracts.
- City determines snow routes.
- Local agencies treat our network first, then treat their own.

Q33: Do you monitor contractor's Material Application Rates? (Check all that apply)

There were 24 responses to this question. Table 9 shows the survey responses for monitoring of contractor's material application rates. About 60% of the respondents indicated that agencies provide guidance for application rates to the contractor. However, 38% of the respondents indicated that application rates are monitored as a part of the contract by agencies, while 33% of the respondents indicated that specific application rates for given situations are provided to the contractor as guidance. About 12% of the responding agencies indicated that the contractor determines and is responsible for tracking application rates. One respondent indicated that the agency does not provide or track application rates. Other information provided by the responding agencies regarding the application rate includes:

- We require the contractor to report materials used across the season. So we track usage, not application rates.
- State staff randomly check application rates throughout the winter season.
- Some contract trucks have AVL equipment, but only a portion of [the] fleet. We do monitor app[lication] rates by KYTC [Kentucky Transportation Cabinet] staff.
- We monitor after the winter is over and report usage in the annual report. <http://wisconsin.gov/Documents/doing-bus/local-gov/hwy-mnt/winter-maintenance/workers/2014-2015annualreport.pdf>

Table 9: Monitoring of contractor’s Material Application Rates

Answer Options	Response Percent	Response Count
Guidance application rates are provided to the contractor	58.3%	14/24
Specific application rates for given situations are provided to the contractor	33.3%	8/24
Application rates are monitored as a part of the contract	37.5%	9/24
Contractor determines application rates	12.5%	3/24
Contract is responsible for tracking application rates	12.5%	3/24
Applications rates are not provided	4.2%	1/24
Application rates are not tracked	4.2%	1/24

Q34: How do you set performance standards for contracting services used in snow and ice response?

There were 25 responses to this question. Table 10 shows the survey responses for performance standards for contracting services. Sixty percent of the respondents indicated that they use same standards as in-house staff. Conversely, 20% of the respondents indicated that they do not set any performance standards. Alternatively, 8% of the respondents set performance standards by comparing performance with other similar agencies and another 8% of the respondents set stretch goals (Initial agreeable targets and increase targets based on technological changes). Information provided by the responding agencies regarding the performance standards includes:

- Our previous and current contracts do not have a performance standard for snow removal & ice control. Contractors are paid an hourly rate, self-dispatching, anytime highways have accumulation of snow or slippery conditions.
- Roads are checked by supervisors throughout the storm.
- We have maintenance manual guidance on all winter maintenance activities. <http://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/mntc-manual/default.aspx>
- Standards are set, but enforcement is difficult.

Table 10: Performance standards for contracting services

Answer Options	Response Percent	Response Count
Use same standards as in-house staff	60.0%	15/25
Compare performance with other similar agencies	8.0%	2/25
Set stretch goals (Initial agreeable targets and increase targets based on technological changes)	8.0%	2/25
None	20.0%	5/25
Other (please specify)	24.0%	6/25

Q35: Do you use any of the following “quality control measures” to measure the performance of contractors employed during snow and ice control operations? Please choose all that apply.

There were 24 responses to this question. Table 11 shows the survey responses for quality control measures (QCM) of contracting services. Three-quarters of the respondents indicated that specified time periods to respond for a winter event are one of their QCM followed, and 66.7% of respondents indicated that the highways need to be clear within a certain time after the end of a winter event as their other QCM. Additionally, 33.3% of the responding agencies consider the need to remove snow and/or ice (at a minimum) at specified locations as their QCM. Prior forecasting and anti-icing is used as QCMs by about 20% of the agencies. One responding agency indicated using specified friction levels as its QCM. Finally, 25% of the responding agencies do not have any QCM to measure the performance of the contractors. Information provided by the responding agencies regarding the QCM includes:

- The Department calls contractors, and local agencies are self-dispatching.
- The response time is a contract requirement. The time to return to clear conditions after the storm is our expectation, and used during post-storm reviews to identify areas for contractor improvement.
- Contractors follow our echelons and assist our operations.
- City staff oversee the work of the contractor just like inspection of summer construction contracts.

Table 11: Quality control measures for contracting services

Answer Options	Response Percent	Response Count
Specified time periods to respond for a winter event	75.0%	18/24
Achieve specified friction levels	4.2%	1/24
Prior forecasting and anti-icing	20.8%	5/24
Need to remove snow and/or ice (at a minimum) from travel lanes, turn lanes, intersections, shoulders and interchanges, enforcement areas, and police parking locations prior to the end of the winter event	33.3%	8/24
Highways clear within certain time after end of winter event	66.7%	16/24
None	25.0%	6/24

Q36: How would you compare contracted services to the in-house services for snow and ice response?

There were 18 responses to this question. Table 12 shows the survey responses for LOS comparison between in-house and contracted services. About 40% of the respondents indicated that the same LOS is achieved with contracted services as in-house services. Another 28% indicated decreased LOS compared to in-house services. Only one respondent indicated decreased LOS in the first few years (mostly two years) of contract and then improved LOS over time. Interestingly, none of the responding agencies indicated having improved LOS with contracted services compared to in-house services. Other information provided by the responding agencies regarding the LOS includes:

- They work in conjunction within the same patrol sections.
- We do not compare.
- It really depends on the contractor. Some companies provide high levels of service while some struggle to keep up. It's really a mixed bag.
- Contractors are not used for follow-up or complaint response. That is done by City forces, so there isn't a lot of incentive for contractor to do a great job. Also, they are very

concerned about damaging their equipment, so we often have to be after them about proper down-pressure on the buckets.

- We would prefer additional KYTC [Kentucky Transportation Cabinet] staff and equipment to handle winter operations.

Table 12: LOS comparison between in-house and contracted services

Answer Options	Response Percent	Response Count
Improved Level of Service (LOS) compared to in-house services	0.0%	0/22
Same LOS as in-house services	38.9%	7/22
Decreased LOS compared to in-house services	27.8%	5/22
Decreased LOS in the first few years (mostly two years) of contract and then improved Level of Service over time	5.6%	1/22
Other (please specify)	27.8%	5/22

Q37: Does your agencies provide any incentives/disincentives based on the performance of the contractors used in snow and ice response?

There were 24 responses to this question. About sixty percent (58%) of the respondents indicated that they do not provide incentives/disincentives based on the performance of the contractors used in snow and ice response. Conversely, about 42% of respondents indicated that they do provide incentives/disincentives based on the performance of the contractors used in snow and ice response. Information provided by the respondents on the incentives/disincentives provided by the agencies to the contractor is provided below.

- Bonus potential for consistently exceeding specifications.
- Only that the contract will be renewed if they perform the service adequately.
- We have a Contractor Assessment Program (CAP) where we conduct audits of the contractor and based on their performance they are eligible for a bonus of up to 2% of their annual contract value.
- Financial consequences are applied when performance does not meet standards.
- Penalties for poor performance, excessive down time, problems with drivers, equipment failures, etc.

- Poor performance results in monetary penalties being assessed to the contractor.
- We provide an early sign up bonus to those contractors that complete paperwork in a timely manner and for arriving in 30 min or less ready for work.
- There are liquidated damages for failure to meet certain criteria that are laid out in the contract.

Q38: In your opinion, are there any significant cost differences between contracted services and in-house services?

There were 17 responses to this question. Table 13 shows the survey responses for cost comparison between in-house and contracted services. About 41% of the respondents indicated that there is an increase in cost due to contracted services, while about 12% of the respondents indicated that there is a decrease in cost when contracted services are used. Similarly, 12% of the respondents indicated that there is no difference in cost between contracted services and in-house staff. Information provided by the responding agencies regarding the costs includes:

- I would say the cost is comparable to the service. If they perform like us, their cost is similar. If they don't do so well, we're usually saving money.
- No opinion.
- When we have looked at contracting entire sections of roadway in the past, costs were significantly higher than in-house.
- We know we pay a substantial premium for this work. The problem is that for us to staff up and purchase loaders for such limited work, contracting seems more attractive, or at least less painful.
- The cost can be up to 30-40% more expensive to have contracted services.
- Labor costs are less. Inefficiencies and not following best practices can cost us more. LOS impacts associate[d with] user delay costs [us] too.

Table 13: Cost comparison between in-house and contracted services

Answer Options	Response Percent	Response Count
Decrease in cost due to contracted services	11.8%	2/19
Increase in cost due to contracted services	41.2%	7/19
No difference in cost between contracted services and in-house staff	11.8%	2/19
Other (please specify)	35.3%	6/19

Q39: Did you perform any formal cost-benefit analysis between contracted services and in-house services?

There were 20 responses to this question. About three-quarters of the respondents indicated that they did not perform any formal cost-benefit analysis to compare contracted services and in-house services. About 25% of the respondents indicated that they did perform a formal cost-benefit analysis between contracted services and in-house services. Information provided by the respondents on the cost-benefit analysis conducted by agencies is provided below.

- Basic hourly comparison. Use hourly contracted services because NHDOT [New Hampshire DOT] is staffed for summer maintenance and need to ramp up for winter.
- <http://www.transportation.alberta.ca/Content/docType34/Production/outsourcing.pdf>
- In order to justify new employees we did an extensive cost analysis and found that having state employees for winter is more cost effective.
- Majority of our work has been contracted out for so long that we just accept that it is cheaper to do it this way.

Emergency Deployments

Q40: During emergency deployments (during extreme weather conditions - snow events, flooding, etc.), how do you coordinate with contracting services?

There were 19 responses to this question. Table 14 shows the survey responses for contracts during emergency deployments. About 32% of the respondents indicated that it is the responsibility of contractors to deploy additional resources (at additional cost paid to the contractor) during emergency deployment, while about 26% of the respondents indicated that it is the responsibility of contractors to deploy additional resources and bear the additional cost. About 16% of the respondents indicated that the agency provides additional resources (labor and equipment) from other parts of the state to contractors. Finally, 26% of the respondents indicated emergency deployments are not required by contracted forces. Information provided by the responding agencies regarding emergency deployments includes:

- The thought is that events and costs balance out over longer term contracts (7 years plus).
- Our contractors are again hourly and at will. They do have "extra" equipment that may be signed up but not typically used available for severe events.
- We have additional contractors on stand-by for emergencies and we move additional resources from other areas of the state in advance of the storm if conditions allow.
- Only used in extreme winters.
- Unless under severe circumstances, the city bears any additional costs.
- Winter operations are fully resourced to meet performance targets under 90 percentile storm severity. Minimal shift in resources for extreme events.
- During extreme storm weather conditions we coordinate resources that are under contract. If not on contract then we negotiate prices.
- Contractors are called in for most all winter events. Decisions to call-in contractors are made at the district level.
- We hire enough equipment to handle most winter events. Plan for the worse and if extreme weather does come we can ramp up, move resources and personnel to handle.

- They are coordinated through the statewide EOC [Emergency Operation Center].

Table 14: Contracts during emergency deployments

Answer Options	Response Percent	Response Count
Agency provides additional resources (labor and equipment) from other parts of the state to contractors (no cost sharing – only resources shared)	15.8%	3/19
It is the responsibility of contractors to deploy additional resources and bear the additional cost	26.3%	5/19
It is the responsibility of contractors to deploy additional resources at additional cost paid to the contractor	31.6%	6/19
Emergency deployments are not required by contracted forces	26.3%	5/19

Q41: If contractors are not responsible for emergency deployments how does your agency address the need for additional resources during extreme winter events?

There were 10 responses to this question. Table 15 shows the survey responses for agencies’ action during emergency deployments. Thirty percent of the respondents indicated that their agency recruits additional contractors only for emergency deployments and 20% of the respondents indicated that the agency uses their own resources to coordinate emergency deployments. However, none of the responding agencies provides additional short term subcontracts to address the added cost. Information provided by the responding agencies regarding the emergency deployments includes:

- Only used during extreme winters.
- Winter operations are fully resourced to meet performance targets under 90 percentile storm severity. Minimal shift in resources for extreme events.
- We would likely recall the contractors for additional shifts as needed, and scrape around our resources to meet the demand.
- We can pull in equipment and personnel from other, unaffected districts, if the need arises.
- All decisions made at the EOC [Emergency Operation Center].

Table 15: Agencies’ action during emergency deployments

Answer Options	Response Percent	Response Count
Our agency provides additional short term subcontracts to address the added cost	0.0%	0/10
Our agency uses their own resources to coordinate emergency deployments	20.0%	2/10
Our agency recruits additional contractors only for emergency deployments	30.0%	3/10
Other (please specify)	50.0%	5/10

Safety

Q42: Do you set any safety standards for the contractors employed during snow and ice response? Examples: speed limit for snow plows, mandated drug and alcohol testing, etc.?

There were 23 responses for this question. About 65% of the respondents indicated that they set safety standards for the contractors employed during snow and ice response. Another 35% of the respondents indicated that they do not set any safety standards for the contractors employed during snow and ice response. Information provided by the responding agencies regarding the safety standards for contracted services includes:

- Standard operating procedures for plowing and material application includes optimum speed limits. Contractor safety is monitored by work safe (provincial agency).
- Limited. Speed and lighting is addressed in the [contract] specs and the vehicle must be inspected.
- Need to adhere to all state and federal regulations.
- This is all under the Cities control.
- They are subjected to the same standards as our operators.
- Part of the guidelines; drug/alcohol testing is a federal mandate as part of holding a Commercial Driver License (CDL).
- Equipment speed limits, lighting requirements, operator training, Health & Safety training.
- All equipment is required to have at least one flashing amber warning light.
- They are responsible for their own licensing, safety and D&A [drug and alcohol] requirements that go along with licensing.
- Required to have a Class B CDL, drug tested, cover plow operations/safety in annual training.

- Speed is monitored during both plowing and spreading operations. We utilize agency representatives to do so.
- We give guidance on speed, bridges, required programs for drug and alcohol testing, certified licensed drives etc.
- CDL

Q43: Are there any differences in the operator accident rates or damage to equipment for contracted vs. in-house forces operating in similar conditions or similar area?

There were 18 responses to this question. About 50% of the respondents indicated that they do not track accident rates of contractors. Another 39% of the respondents indicated that there is no difference in accident rates/damage to equipment between contracted services and in-house staff. Interestingly, no respondents mentioned an increase or decrease in accidents due to contracted services, with the exception of the comments below.

- There has been an increase in collisions with plow trucks, but we do not feel that it is because of the contractor's actions - overall traffic volumes have increased and drivers are driving faster than past years.
- Many more accidents with the vendors. With so many more contractors than in house forces the odds are greatly stacked in favor of more accidents involving the vendors.

Table 16: Agencies action during emergency deployments

Answer Options	Response Percent	Response Count
Decrease in accident rates/damage to equipment with the use of contracted services	0.0%	0/21
Increase in accident rates/damage to equipment with the use of contracted services	0.0%	0/21
No difference in accident rates/damage to equipment between contracted services and in-house staff	38.9%	7/21
We do not track accident rates of contractors	50.0%	9/21
Other (please specify)	11.1%	2/21

Q44: Are contractors required to be responsible for any damage (life and property) during snow and ice control?

There were 23 responses to this question. About 70% of the respondents indicated that contractors are responsible for any damage (life and property) during snow and ice control. No respondents indicated that the agency is responsible for any damage (life and property) during snow and ice control. The other 30% of the respondents provided the following comments regarding responsibility for any damage (life and property):

- Contractors are required to carry extensive liability insurance to protect against litigation.
- Risk management included in contracts if utilized.
- Cities responsibility.
- Yes...municipal contractors are indemnified by the state as part of the contract as long as the contractor is not negligent (e.g. disregarding safe operation standards).
- Liability Insurance.
- Insured through the state.

Issues with Contracted Services

Q45: Has your agency reverted (from contracted forces back to state forces) to using agency resources instead of contracted services?

There were 22 responses to this question. About 86% of the respondents indicated that they have not reverted from using contracted forces back to state agency resources, while about 14% of the respondents indicated that they partially reverted back to using agency resources instead of contracted services. Interestingly, none of the agencies completely reverted back to using agency resources instead of contracted services. Specific reasons given by the responding agencies for partially reverting back using agency resources include:

- We have in specific areas due to a lack of replacement contractors, but it hasn't been a philosophical decision.
- In some areas contractors have gone out of business with no replacement available. Also some local agencies have not renewed agreements to limited personnel and equipment.
- There have been instances where counties have pulled their service, and we have had to cover those routes with direct forces.

Table 17. Agencies that have reverted from using contracted forces back to in-house forces.

Answer Options	Response Percent	Response Count
Yes, completely	0.0%	0/22
Yes, partially	13.6%	3/22
No	86.4%	19/22
If yes, please explain why, how, costs, etc.		3/22

Q46: Has your agency had to terminate a contract for any reason within the last 5 years?

There were 22 responses to this question. Fifty percent of the respondents indicated that they have had to terminate a contract within the last 5 years. Another 50% of the respondents indicated that they did not have to terminate a contract within the last 5 years. Specific reasons given by the responding agencies for terminating contracts include:

- Sometimes firing a contractor can be every bit as difficult as an employee. For one of them, you would need to read the actual letter (you wouldn't believe the list). For another, it was just poor performance over and over again.
- Again at will contracts so if poor performance we no longer call contractor in for work.
- Non-Performance.
- Complaints about a contractor, numerous incidents involving contractor. We do not want any problem contractors.
- Poor performance; or for realignment of in-house resources whereby we can provide the service in place of the municipal contractor.
- By mutual agreement in one instance.
- Due to dangerous operations, wasting of resources, absenteeism, insubordination, etc.
- On rare occasion for extremely poor performance.
- Poor contractor performance.
- We have the ability to fire a contractors for several reasons and the procedures are spelled out in the contract.

Q47: Have you had any contractors terminate contracts for any reason?

There were 21 responses to this question. About 52% of the respondents indicated that they never had a contractor terminate a contract, while 48% of the respondents indicated that they have had situations where contractors terminated a contract. Specific reasons given by the responding agencies for contractors terminating a contract include:

- With the lump sum contracts, two bad winters in a row can thin out the contractors. Sometimes they will rebid if we re-advertise, but the price goes up significantly.
- At will. May have sold trucks or [the] company [goes] out of business, or we don't pay enough.
- Yes, they went out of business or the owner died.
- Usually when they feel they are not paid enough.
- Increased costs associated with insurance.
- Doing snow and ice for the state is a business choice and if a contractor does not want to continue we will just go to the next contractor willing to put another piece of equipment on.
- Not terminate, but contractors have gone bankrupt in the past.
- Claim that they lacked resources to maintain their network and ours.

Q48: Are there any specific lessons learned when contracting snow and ice operations? Please explain.

Below are the list of responses provided by the responding agencies.

- You need to work with contractors like employees. People are people - just treat others as you would [like to] be treated and most will do well by you. Be ready to take things back and shift around the contracted areas if necessary. If you ever let go of your own talent completely, you will pay higher prices.
- Working hand in hand with the private contractors has worked well for NH for decades.
- The hardest thing to do was to give up control and direction of the contractor's work. But our contracting model has worked, in my opinion because the contractor's employees (foremen, operators) take the same 'ownership' of highways as we had, when the work was done in-house.
- Monitoring application rates of contractors, and the work they are doing it [snow and ice control] difficult. Too many contractors and not enough state forces to watch them.
- Important to have mutual understanding of performance requirements and to maintain local communication.
- We only contract forces for utilization during intense snow and ice events.
- Yes, a LOT! Truck and equipment specs are necessary, material rates monitored, driver hours monitored, shift changes, number of trucks allowed per vendor, maintenance of equipment, bid process, etc.
- The best guidance is to have a comprehensive contract that is detailed enough to explain what you need and require from the contractors. The second component is to have trained personnel to manage the contractors. If you are to have a combined workforce the bottom line is to provide safe roads at a reasonable cost. The goals have to be the same.
- Make sure that your expectations are included in the contract. Get the contract out early in the season.
- We've found that over time our way of doing maintenance is cost effective because there is no profit motive and the operators live in the areas they maintain so they will go the extra mile.

Appendix C
Final Report Presentation

NORTH AMERICAN STUDY ON CONTRACTING SNOW AND ICE RESPONSE

Laura Fay and Anburaj Muthumani
Western Transportation Institute

Dave Bergner
Monte Vista Associates

Jason Bittner
Applied Research Associates



Objective

- To gain an understanding of the state of the practice in contracting for snow and ice control by state DOTs.



Background

- Snow and ice removal requires instantaneous and efficient response paired with reliable availability of equipment and manpower.
- Response times are crucial and every storm event is different, demanding flexibility in the use of limited resources.

Background

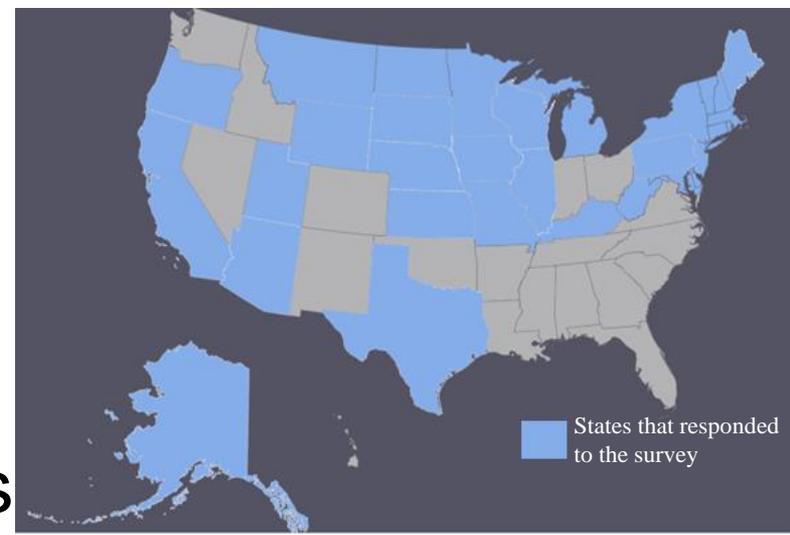
- Unpredictable winter weather has a profound effect on the overall value of work related to snow and ice removal.
- Some budget cycles see double or triple the expected expenditures based on the intensity and duration of snow events.

Background

- With this uncertainty, and the importance of maintaining mobility in winter conditions, many states have adopted alternative delivery approaches for winter maintenance activities.
- While these contracted activities do not shift the costs of snow responses entirely to outside parties, the contracts are used to provide some stability and ensure an appropriate response to maintain highway infrastructure.

Methodology

- Literature Search
 - Used to develop the survey questionnaire and synthesis
- Survey
 - 51 responses from 31 US states, and 3 Canadian provinces
- Synthesis of Information
 - Process collected information into a summary chapter in the final report
- Final Report and Presentation



Final Report Outline

- Executive Summary
- Introduction
- Methodology
- Literature Review
- Survey Summary
- **Summary of Findings**
- Conclusions & Recommendations
- Appendices – Detailed Survey Responses



Summary of Findings

- Why use Contracted services?
 - Changes in LOS expectations
 - Lack of in-house resources (people and \$\$)
 - Movement toward performance based operating policies => LOS beyond what in-house staff can achieve
 - Unusual storm events, extreme storms
 - Seasonal variation in staff and equipment needs => staffing/equipment imbalances
 - Staff training and retention

Summary of Findings

Why use contracted services?

Answer Options	Response Percent	Response Count
Lack of agency resources - caps on labor	48.0%	12/25
Lack of agency resources - equipment fleet	48.0%	12/25
A state-level movement toward privatization (legislative action)	24.0%	6/25
Added lane mileage	16.0%	4/25
Effort to reduce cost using contracted services	24.0%	6/25
Difficulty in retaining & replacing skilled workers	20.0%	5/25
Difficulty in obtaining, retaining & maintaining snow and ice control equipment	8.0%	2/25
Proximity of resources to snow and ice control service area (e.g. excessive distance from in-house resources)	8.0%	2/25

Summary of Findings

Reasons why agencies are NOT using contracted services?

- Increased cost
- Variation in response time
- Reduced level of service
- Non-availability of contractors
- Non-availability of specialized equipment and labor from contractors
- Surplus and efficient in-house staff
- Limited agency contracting system

The most commonly cited factor for states to resist contracting services was the desire to retain key skills and expertise.

Summary of Findings

The Quality of Contractor Performance

- 50% of responding agencies indicated that they have had to terminate a contract within the last 5 years
- Reasoning:
 - One of the common reason is non-performance and/or poor performance by the contractors.

Summary of Findings

The Quality of Contractor Performance

- ~14% of respondents have partially reverted back to using agency resources instead of contracted services (but 86% have not)
- Reasoning:
 - Issues related to non-availability of replacement contractors.

Summary of Findings

The Quality of Contractor Performance

- 48% of respondents indicated that they have had situations where contractors terminated a contract.
- Reasoning:
 - Bankruptcy of contractors,
 - Contractors out of business,
 - Dissatisfaction with the pay by agencies.

Summary of Findings

State DOT Contracting

- State DOTs hire private contractors or local public agencies for snow and ice control.
- The majority of states are using private contractors.
- A very limited number of respondents contract with both private and local public agency staff

Summary of Findings

Types of Contracts

- Rental Agreements or Short-term Contracts
 - Used in extraordinary circumstances (severe storms, hauling excess snow, etc.)
- Terms:
 - Fixed annual payment (based on estimate)
 - Hourly payment (labor and equipment with a minimum guarantee*)
 - Indexed Lump Sum (based on estimate (per lane mile), adjustment for storm severity, minimum guarantee*).

Summary of Findings

Types of Contracts

- Defined amount of Work or Recurring Work
 - defined amount of work on a recurring basis for an agency, may include contracts with local agencies (county or city), private individuals, or firms to provide snow and ice control on state routes.
 - Local agencies are often reimbursed for the cost of using the equipment, materials, and workers without profit.
- Terms – long term, may include indexed payments.

Summary of Findings

Types of Contracts

- Blended Forces
 - Both state forces and contractors (private firm or public agency), with contractors handling the majority of statewide effort.
 - Used in extraordinary circumstances to provide support.

Summary of Findings

Types of Contracts

- Public-Private Partnerships
 - Involves a comprehensive contract mechanism including asset management contracts and public-private partnerships.
 - Not very commonly used

Summary of Findings

Types of Contracts

Answer Options	Response Percent	Response Count
Agreements for equipment and operator (during normal winter circumstances)	48.0%	12/25
Long term contracts (up to 5 years or more)	44.0%	11/25
Short term contracts (1 to 3 years)	36.0%	9/25
Fixed Lump Sum; Fixed Annual Payment of Estimated expenditures regardless of winter severity.	36.0%	9/25
Blended forces (in-house and contracted services working together)	32.0%	8/25
Agreements for equipment and operator (only during extraordinary circumstances)	20.0%	5/25
Defined amount of work (for a particular road segment)	20.0%	5/25
Time and Materials; Labor, Materials and Equipment) w/Guaranteed minimum payment (e.g., portion of contract value)	20.0%	5/25
Performance based contracts	16.0%	4/25
Limited services (after storm clean-up, parking lane clearing, hauling snow, etc.)	16.0%	4/25
Public-Private partnership derived contracts	12.0%	3/25
Indexed Lump Sum; Contract paid per lane mile for estimated expenditures with adjustments for change in scope of work (harsher or mild winters) w/ Guaranteed minimum payment (e.g., portion of contract value)	8.0%	2/25



Summary of Findings

Contracting - Lessons Learned

- *The primary observation for contract success is communication* – clear, open, and honest partnerships between the state and vendors.
- The overall goals of both the contractor and the state need to be the same to ensure success.
- Partnerships even require some willingness to compromise and relinquish controls to allow a shared sense of ownership.

Summary of Findings

Contract Duration

- *Contractors may initially show decrease performance within in the first few years of a contract, after which time performance improved significantly.*
- Contractors need training and time to learn as they go in the first few snow events
- Contractors should be given sufficient time to make a return on their start-up investment expenses.

Summary of Findings

Contract Duration

- 3 to 5 year contracts with extensions based on success of the existing contractor have been shown to be effective.
- 90% of respondents have been using contracted services for 15 or more years.
 - ~10% have been using contracted services 3 - 10 years.
 - ~63% of these contracts were established specifically for winter maintenance ops.

Summary of Findings

Qualification and Training

- Pre-qualification
 - Contractors meeting requirements in finance, staffing, equipment, experience, inspections, cost, insurance, etc.
- About 60% of respondents use a pre-qualification process.

Summary of Findings

- Pre-qualification Example:
 - Three-tiered system.
 - Tier one: Contractor demonstrating sufficient insurance and bonding. Result will be pass or fail. Contractor has to pass to advance to next tier.
 - Tier two: Service proposal demonstrating the approach to the work (number of plows, number of staff, where the yards will be located etc.). Service proposal is worth 30% of the final score (out of 100). Contractor must get a minimum of 15 points to continue to advance to next tier.
 - Tier three: Based on the cost quoted. Cost proposal is worth 70% of the final score (out of 100).
 - Contractor with the most points will be successful proponent.

Summary of Findings

Qualifications and Training

- Most state agencies do not have demanding pre-qualification and training criteria for contractors involved in snow and ice control.

Summary of Findings

Qualifications and Training

- *About half of the survey respondents indicated that the contractors' personnel need to have experience and/or approved training.*
- *About half also indicated the contractors, or funding agency, do not require additional training for personnel after the contract is awarded.*

Summary of Findings

Answer Options	Response Percent	Response Count
Yes (Paid for training time)	34.8%	8/23
Yes (Not paid for training time)	13.0%	3/23
No	52.2%	12/23

- Examples of the experience and/or approved training required by agencies may include:
 - Commercial Driver's License (CDL),
 - two years of plowing/spreading experience,
 - training from contractors or agencies prior to winter season.

Summary of Findings

Qualifications and Training

- This means that many agencies are hiring contracted employees who may have little or no training in snow and ice control operations.
- In particular, seasonal or part time employees hired through contractors may have insufficient experience to adequately handle snow and ice control activities.



Summary of Findings

Equipment and Snow & Ice Control Materials

- Private contractors tend to use their own equipment while contracted local public agencies share their equipment with the state DOTs.



Summary of Findings

Equipment and Snow & Ice Control Materials

- 88% → contractors provide the equipment used for the snow and ice control operations.
- 83% → contractors are responsible for equipment calibration.
- 72% → contractor's equipment needs to be maintained to meet specific standards.
 - Routine mechanical inspections and calibration for spreaders (supervised by agency staff).

Summary of Findings

Equipment and Snow & Ice Control Materials

- Interestingly, about *12% of survey respondents indicated that no equipment calibration is required.*



Summary of Findings

Equipment and Snow & Ice Control Materials

- Private contractors are most commonly provided with snow and ice control materials by agencies
- While contracted local public agencies are encouraged to purchase their own materials and then be reimbursed.

Summary of Findings

- 55% → Agencies provide snow and ice control materials (salt, sand, liquid chemicals, etc.)
- 20% → Contractor provides the snow and ice control materials.
- Other options include:
 - contractors purchase some materials and agencies provide the other snow and ice control materials.
 - local agencies given the option to procure products, with the reimbursement of the cost being based on the amount of salt spread.

Summary of Findings

The Cost of Contracting

- It is not clear if the costs of contracting snow and ice control operations are greater than using in-house services.
- Cost information is not often compared and confounding factors such as LOS expectations complicate the analysis.

Summary of Findings

The Cost of Contracting

- Only about 25% performed formal cost-benefit analysis between contracted services and in-house services.
 - 1) An increase in costs when using contracted services (using a basic hourly rate comparison) [New Hampshire DOT].
 - 2) A 30 to 40% increase in costs when using contracted services (based on an extensive cost analysis) [Massachusetts DOT].

Summary of Findings

The Cost of Contracting

- 41% respondents reported an increase in cost due to contracted services
 - 12% respondents reported a decrease in cost
 - 12% indicated no difference in cost.
- *Cost appears to be associated with LOS.

Summary of Findings

Safety Issues and Experiences

- Most agencies either think that there is no difference in accident rates or they do not track accident rates when comparing in-house and contracted services.
- 65% set safety standards for the contractors employed during snow and ice response (35% do not).

Summary of Findings

Safety Issues and Experiences

- Example safety standards set by agencies include:
 - Speed monitoring during plow and application,
 - Mandated drug and alcohol testing,
 - Lighting requirements for vehicles,
 - Holding a Commercial Driver License (CDL)
 - Guidance on bridges.

Summary of Findings

Safety Issues and Experiences

- Accident rate data???
- *None of the responding agencies reported a decrease in accident rates with the use of contracted services.*
- 70% indicated that contractors are responsible for any damage (life and property) during snow and ice control.
- In some cases, the state agency pays for the local agencies as long as the contractor does not disregard safety operations.

Summary of Findings

Emergency Management

- A storm, series of storms of intensity, accumulation, and duration to overwhelm an agency or contractor's capabilities may require coordinated deployment of emergency contractors.
 - *An agency may call upon additional contractors with extra or special capabilities who normally are not involved in snow removal.*

Summary of Findings

Emergency Management

- 32% of respondents indicated it is the responsibility of contractors to deploy additional resources (at additional cost paid to the contractor by the agency).
- While 26% of respondents indicated it is the responsibility of contractors to deploy additional resources and bear the additional cost.
 - More common with longer term contracts

Summary of Findings

Emergency Management

- 16% of respondents indicated the agency provides additional resources (labor and equipment) from other parts of the state to contractors.
- While 26% of respondents indicated emergency deployments are not required by contracted forces.

***These terms needs to understood well in advance of emergency situations.**

Summary of Findings

Emergency Management

- Agencies tend not to pay additional cost for long-term contractors involved in emergency deployments.
- Local agencies and short-term contractors may get “additional cost paid” and/or “shared resources.”

Summary of Findings

Emergency Management

- Where contractors are not responsible for emergency deployments,
 - 30% of respondents indicated the agency recruits additional contractors only for emergency deployments
 - 20% of respondents indicate the agency uses its own resources to coordinate emergency deployments.
- *One respondent indicated they bring resources from unaffected districts during emergency deployments.

Summary of Findings

Emergency Management

- FEMA Compliance
 - When agencies develop contracts they should comply with the rules and requirements governing procurement, documentation, and payment in order to aid in receiving federal disaster assistance.
 - Consider all possible contractors, negotiate expected work and rates ahead of time, etc.

Summary of Findings

Incentives and Disincentives

- In general incentives and disincentives are not commonly used with contracted snow and ice response.
- Incentives may be for:
 - Equipment/technology purchases,
 - Equipment financing arrangements,
 - Training and certifications,
 - Performance (material usage, time to bare pavement, operational speed recovery, etc.)

Summary of Findings

Incentives and Disincentives

- Incentives => increase in pay rates or bonuses
- Disincentives may include termination of contracts.



Summary of Findings

Incentives and Disincentives

- Contracts can be structured to include incentives and disincentives based on performance...
 - The National Highway System in the District of Columbia saw a 300% increase in overall highway rating as performance of the contractor improved due to bonuses (Hyman, 2009).

Summary of Findings

Incentives and Disincentives

- 20% of agencies provide incentives to encourage the use of advanced technologies.
- In some cases, advanced technologies are mandated as a part of the contract or agencies provide the advanced technologies.

Summary of Findings

- Lessons Learned from Survey Respondents:
 - Mutual understanding between the contractor and the agency.
 - More comprehensive contracts with specific details for equipment, monitoring of snow and ice control equipment and materials.
 - Trained personnel to manage the contractors.
 - Inclusion of expectations.
 - Giving up control and direction to the contractors, to give contractors a sense of ownership.

Summary of Findings

Effective Practices

- *Develop a working partnership between the state and the contractor (public or private)*
- *Clear communications strategies and contract terms and conditions*
- Identify performance standards for various storm durations (labor, material, equipment, etc.)
- Clear and concise contracts

Summary of Findings

Effective Practices

- Adopt contract language that maximizes the opportunity and responsibility for the contracted party to prove responsiveness, efficiency and/or effectiveness in producing snow and ice response to the public.

Conclusions

- Generally available information on contracted services is provided in the context of general maintenance, rarely specifically addresses contracted services for winter maintenance operations.



Conclusions

- The main reasons for agencies to seek contractors for snow and ice response include;
 - 1) lack of resources,
 - 2) a state-level movement toward outsourcing or privatization, and
 - 3) cost comparisons

Conclusions

- Winter maintenance agencies use four types of contracting methods for snow and ice response:
 - 1) rental agreements or short-term contracts,
 - 2) defined amount of work or recurring work contracts,
 - 3) blended forces and
 - 4) asset management and public-private partnership contracts.

Conclusions

- Performance-Based Maintenance Contracts (PBMC) are a contracting option.
- PBMC, winter maintenance agencies usually set a minimum Level of Service (LOS) and response time to measure the performance.

Conclusions

- In most cases, winter maintenance agencies rely on contractors for snow and ice equipment.
- Conversely, snow and ice control materials (salt, sand, etc.) are commonly provided by the winter maintenance agencies.

Conclusions

- Studies have shown the need for minimum standards for the equipment used by contractors such as;
 - replacement time of aging equipment
 - upgrading to new technologies.

Conclusions

- It is generally perceived that urbanized areas, which have a higher density of contracting firms, are a more favorable environment to use contractors for snow and ice control functions.
- However, contractors are willing to work in remote areas if the size and duration of contracts are large enough.

Conclusions

- It is generally perceived that contracting potentially reduces the cost for highway winter maintenance operations.
- However, the benefits of using in-house versus contracted services may be more qualitative than quantitative.

Conclusions

- Evidence of contracting resulting in improved LOS is inconclusive.
- Studies reported contractors either have improved LOS compared to in-house or provide the same LOS as in-house.
- However, there is a high chance of decreased performance in the first few years of contracting.

Conclusions

- Winter maintenance agencies have quality control measures to ensure that contractors are providing the best possible LOS for the public.
- This has been achieved through well-defined goals and objectives for contractors.

Conclusions

- In some cases of poor performance by contractors, winter maintenance agencies either:
 - penalized contractors,
 - terminated the contractors,
 - or reverted to in-house service.

Recommendations

- When contracting for snow and ice response contract language should address;
 - the responsibility of equipment calibration,
 - how often equipment should be calibrated,
 - and who is responsible for the calibration.
- *This is an area where large improvements could be seen in accuracy of applications.

Recommendations

- To ensure the highest level of snow and ice response, the contracting agency should consider including:
 - minimum pre-qualifications to qualify for a contract,
 - annual training for contracted staff.

Recommendations

- Available cost data related to use of contracted services for snow and ice response is inconclusive.
- We recommend cost data be collected and compared between the use of in-house services and contractors.
- There is a need to compare costs on even terms, e.g., similar LOS expectation.

Recommendations

- There appears to be a lack of available data on safety and performance of contracted snow and ice response compared to the use of in-house resources.
- We recommend conducting a safety study on crashes, accident rates between in-house and contracted service staff.

Thank you!

Questions?

Laura Fay

laura.fay1@montana.edu

406.600.5777



research for winter highway maintenance

Lead state:

Minnesota Department of Transportation
Research Services
395 John Ireland Blvd.
St. Paul, MN 55155