Performance Measures for Snow and Ice Control Operations

Thomas H. Maze
Center for Transportation Research and Education
Iowa State University
2711 S. Loop Drive, Suite 4700
Ames, IA 50010-8664
tmaze@iastate.edu

Chris Albrecht
Center for Transportation Research and Education
Iowa State University
2711 S. Loop Drive, Suite 4700
Ames, IA 50010
calbrech@iastate.edu

Dennis Kroeger
Center for Transportation Research and Education
Iowa State University
2711 S. Loop Drive
Ames, IA 50010
kroeger@iastate.edu

ABSTRACT

Under the NCHRP 06-17 project, the research team surveyed snow and ice control organizations in the United States, Canada, Europe, and Asia to determine the current trends in performance measurement. The team also inquired about the methods used in developing these programs in order to determine a practical, user friendly method to assist snow and ice control managers in developing a performance measurement system that uses traditional and nontraditional performance indicators and measurement issues. To achieve the project objectives, the researchers issued a survey to snow and ice control agencies throughout North America, Europe, and Asia to obtain data on the performance indicators and measures used, if any, by these agencies. The identified performance indicators and measures were then categorized, defined, and assessed for their usefulness. A process was then developed to assist snow and ice control operations managers in preparing a customer-focused, environmentally friendly performance measurement program.

Key words: performance measurement—snow and ice control—winter maintenance
INTRODUCTION

The issue of performance measurement for snow and ice control has been a topic of much interest. Developing meaningful data for snow and ice control has produced a variety of responses and differing goals and objectives. However, a rigorous process that the snow and ice control industry can use to determine the most appropriate performance measures and indicators has been lacking.

Research was needed to examine current trends and issues and develop a process that can be used by snow and ice control agencies to prepare a performance measurement system that is sensitive to organizational and public needs as well as environmental concerns.

The research would also analyze the different dimensions along which an agency’s performance could be defined, measured, and interpreted based on an agency’s goals and objectives.

Under the NCHRP 6-17 project, the research team surveyed snow and ice control organizations in the United States, Canada, Europe, and Asia, to determine the current trends in performance measurement. The team also inquired about the methods used in developing these programs in order to determine a practical, user friendly method to assist snow and ice control managers in developing a performance measurement system that uses traditional and nontraditional performance indicators and measures issues. The plan provides a list of options of performance indicators and measures and explains how to incorporate the indicators and measures in the decision making process to monitor and improve snow and ice control operations.

To achieve the project objectives, the researchers first reviewed pertinent literature and research findings in the area of performance measurement systems. Next, a survey was issued to snow and ice control agencies throughout North America, Asia, and Europe to obtain data on the performance indicators and measures used, if any, by these agencies. These performance indicators and measures were then categorized by functional type and were fully defined. An assessment of the usefulness of each was prepared. The research team then summarized the theory and practice of the performance measurement. The performance measures were then identified by their key aspects and identifying performance indicators and measures that may have applicability in snow and ice control operations. A process was then developed to assist snow and ice control operations managers in preparing a customer-focused environmentally friendly performance measurement program.

The purpose of this research is to provide a synthesis of measures used throughout the world to evaluate the performance of winter maintenance activities (snow and ice removal from roadways) and to make recommendations for further development of the most promising measures. The research was conducted in two parts. The first part entailed a comprehensive review of performance measures that have been and are currently being used by transportation agencies around the world. This was done through a thorough review of the literature and a survey of dozens of agencies with winter maintenance responsibilities. In the second part, the list of performance measures was narrowed to a few that offered the most promise. In other words, these were measures with the most potential to be applied economically to a roadway network and provide reliable, repeatable, and comparable measures of performance. These most promising measures were then recommended for further development.
PERFORMANCE MEASUREMENT

For many transportation agencies, performance measurement has become a critical issue in the last five to ten years, and several significant contributions to the literature have been made on the fundamentals of how transportation agencies should tie strategic direction and agency mission to performance measures.

Performance measurement is one component of a larger “quality in government services” movement. The growing emphasis on performance measurement by transportation agencies has not been addressed sufficiently because there wasn’t a need to measure performance in the past but also due to two forces:

1. A culture at transportation agencies that has historically focused on standards and specification for physical conditions or level of service (LOS). Generally, transportation agencies have defined the LOS or conditions of a facility based on static standards.
2. The vast expansion of information technology and the ability to collect information that would have been too costly or impossible to collect in the past has made the collection of performance-related data possible.

Measurement of Winter Maintenance Performance

Although winter maintenance is a critical activity, there are no standard methods for measuring performance for either agency programs or programs led by contractors. The lack of standard measures makes it difficult to manage and control winter maintenance activities and subsequently impossible to benchmark and make comparisons both between and within maintenance programs. Measuring the performance of winter maintenance makes it possible to make intelligent management tradeoffs between agency costs and user costs.

Agencies that currently measure winter maintenance performance do so from one or more of three basic perspectives:

- **Inputs.** Input measures represent the resources spent or utilized to perform snow and ice control operations. These include fuel usage, labor hours, machinery or equipment hours, and units of anti-icing materials or abrasives. The level of inputs is directly proportional to agency costs and, therefore, they most easily and most commonly are measured by transportation agencies. Because inputs are applied at the beginning of the winter maintenance process, they are unable to help management assess the efficiency, quality, and effectiveness of winter maintenance.

- **Outputs.** Outputs quantify the resulting physical accomplishment of work put forth in applying resources in winter maintenance. Outputs might include the lane miles plowed or sanded, the number of lane miles to which deicing materials were applied, lane miles of anti-icing brine applied, and other accomplishments of the maintenance process in units of work. Outputs are generally more useful than inputs alone because inputs and output together can help to define how technically efficient winter maintenance operations are performing. In other words, they can tell the winter maintenance manager what level of input was or will be required to achieve a level of output. These measures may also be based on time and storm event.

- **Outcomes.** Performance measures that seek to measure outcomes take into account the relative effectiveness of the winter maintenance activity, very often from the perspective of the user or customer. Outcomes are inherently more difficult to measure. A desired outcome of winter maintenance might include the improvement of safety, mobility, and/or user satisfaction. Safety, mobility, and user satisfaction are abstract concepts and, therefore, are measured through
indicators that are known to be related to the desired outcome. For example, safety might be measured through pavement friction or through the reduction in number of crashes.

**Putting Winter Maintenance Performance Measurement into Context**

To make comparisons between and among jurisdictions, differences in the severity of storms must also be taken into account. The severity of a storm impacts the performance of winter maintenance. To illustrate the relationship between inputs, outputs, outcomes, and the environment, a fishbone diagram is shown in Figure 1. The top of the figure shows some of the environmental inputs. On the bottom are labor, equipment, and materials inputs for removing snow and ice from the roadway network. In the arrow, the results of the interaction between the environmental variables and the inputs to snow and ice removal are shown.

![Figure 1. Relationship between inputs, outputs, and outcomes](image)

In this case, we have identified satisfying the customer (the road users) as our desired outcome, and because shorter time to bare pavement is related to higher levels of satisfaction, time to bare pavement is the resulting performance measure. The measurement of time to bare pavement must be supported by a specific data collection methodology.

**Summary of Synthesis Findings and Assessment**

Various instances of research and testing of proposed performance measures were described in literature but often without implementation or field testing. It appeared that a handful of European countries and Japan are more progressive in terms of developing and implementing winter maintenance performance measures, likely because more snow and ice control operations are contracted to private companies internationally than in the United States.

The survey of winter maintenance personnel was sent to 162 agencies covering the U.S. Snow Belt states, Canadian provinces, northern Europe, and Japan. In all, 39 agencies responded to the survey, with responses covering agencies that did no snow and ice control performance measurement to those that incorporated performance measures into their management plans. Most performance measures cited by the respondents are tied to their accounting and management systems. These measures include lane miles plowed, personnel and/or overtime hours, tons of material used, amounts of equipment deployed, and cost of operations.
Other measures used by some of the respondents include time to bare pavement, time to return to a reasonably near normal condition, length of road closures, and customer satisfaction. The majority of the measures critical to the respondents’ snow and ice control operations focused on public safety and mobility.

In all, the survey analysis identified 4 input measures, 5 output measures, and 11 outcome measures used by public agencies to measure snow and ice control performance. A complete list of the performance measures identified can be found in the final report. To identify measures and approaches that warrant further study, the following criteria were applied to the measures and approaches:

**Table 1. Measures and approaches**

<table>
<thead>
<tr>
<th>Measure criteria</th>
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<tbody>
<tr>
<td>Does the measure directly measure safety, mobility, or public satisfaction?</td>
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<th>Approach criteria</th>
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As a result of the assessment, it was determined that outcome measures should be pursued further, because if the measurement of snow and ice control is to have a role in improving safety and mobility, measures of outcome must be pursued. To help determine the measures and approaches to pursue further, the 11 outcome measures observed in this study were reduced to three basic categories. Two approaches are possible for each measure.

**Table 2. Approaches used per measure**

<table>
<thead>
<tr>
<th>Measure: Degree of clear pavement</th>
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<tbody>
<tr>
<td>Approach: Manual observation</td>
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<tr>
<td>Approach: Camera-assisted observation</td>
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</table>

<table>
<thead>
<tr>
<th>Measure: Traffic flow</th>
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</thead>
<tbody>
<tr>
<td>Approach: Detectors—speed, volume, and occupancy</td>
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<tr>
<td>Approach: Road closure</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure: Crash risk</th>
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<tbody>
<tr>
<td>Approach: Friction (or slipperiness)</td>
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<tr>
<td>Approach: Reported Crashes</td>
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</tbody>
</table>
Summary of Key Points

The literature review revealed that a significant amount of published materials deal with different types of performance measures, both in use and theoretical. However, there was a limited amount of literature documenting agencies’ utilization of performance measures in day-to-day practice. Various instances of research and testing of proposed performance measures were described, but often without implementation or field testing by state or local agencies in the United States. It appeared that a handful of European countries and Japan are more progressive in terms of developing and implementing winter maintenance performance measures, likely because more snow and ice control operations are contracted to private companies internationally than in the United States. From this review, the following was discovered:

- Performance measures can be divided into three general categories: input, output, and outcome measures.
- Known input measures include labor hours, equipment hours, various material units, and monies expended.
- Known output measures include cost determined by a unit of accomplishment of work performed (e.g., lane miles plowed or sanded), material application rates, equipping and calibrating trucks, and route characteristics. These measures may also be based on time and storm event.
- Known outcome measures include bare pavement regain time, friction (skid resistance by coefficient of friction), reduction in crashes, duration and frequency of closures, advanced warning time to customers, and customer satisfaction (indicated by customer satisfaction surveys).
- A Pavement Snow and Ice Condition chart, used by some agencies, assists with uniform pavement condition identification by combining traffic flow characteristics and visual observation.
- Various outcome measures can and often are combined to form an overall LOS rating for a roadway.
- Contracts with private sector operators are often written such that reimbursement is based on a combination of input (pay items) and output or outcome measures (expectations).
- Innovative technologies installed on winter maintenance vehicles that aid in the collection of data applied to performance measures include AVL, GPS, friction meters, and various sensors of material, equipment, and temperature.
- Winter weather severity indices have been developed to help quantify the relationship between the severity of winter weather events and roadway condition or safety factors.

The study also provided an inventory and discussion of the winter maintenance performance measures used by states, provinces, cities, and counties. There is a broad range of participation in the uses of performance measurement, as stated by those surveyed. The range is from not measuring performance of snow and ice control at all to establishing sophisticated measures of performance of operations. The landscape of performance measurement is wide ranging. While many agencies stated the need for performance measurement, only a handful of these have established a formal performance measurement process for their operations. In these times of budget challenges, the agencies have focused their efforts on achieving the desired results of effective snow and ice control to meet the demands of the traveling public.
Survey Results

For this project, the study team sent out a survey to 162 winter maintenance operations personnel throughout the world. The targeted survey respondents were from local, state, and federal agencies. The respondents were chosen to provide feedback unique to their areas of expertise.

Of the 162 surveys distributed, 41 were returned, for a response rate of 24%. Within these 41, 20 states responded, as well as 4 Canadian provinces, 1 response from Europe, and 1 from Asia. The remaining respondents included those from cities and counties in the United States and Canada. Figure 3 and Table 1 illustrate the agencies responding to the survey, along with their locations. The surveys were distributed by electronic mail and through the postal service. While this response is not as high as we had hoped it to be, the surveys that were returned provide remarkable insight into the use of performance measures in winter maintenance operations, particularly in the northern hemisphere regions. The respondents were primarily from the United States and Canada.

The responses to the survey covered both ends of the spectrum, from those that did no performance measurement to those that incorporated performance measures into their management plans. Four agencies responded that they do not use performance measures at all, while 34 responded that performance measures were used in some capacity. One agency did not respond. There were also those that indicated that they would like to improve their methods to measure their performance for snow and ice control but weren’t able to obtain the proper data. Clearly there is room for improvement in this area.

Most of performance measures cited by the respondents are tied to their accounting and management systems. These measures include lane miles plowed, personnel hours, overtime hours, tons of material used, amount of equipment deployed, and cost of operations. Other measures used by the respondents include time to bare pavement, time to return to a reasonably near normal condition, LOS, and customer satisfaction. Customer satisfaction was cited by 21 respondents as a performance measure. Additionally, 19 respondents indicated that public was surveyed periodically, either by the department or in a citywide survey. The surveys showed that the public was generally satisfied with their performance. Two respondents indicated that they measured customer satisfaction based on telephone calls or complaints.

The majority of the measures critical to the respondents’ snow and ice control operations focused on public safety and mobility. Obviously, these subjects are central to the role of all transportation agencies, so it makes sense that the performance measures would focus on these subjects. By maintaining mobility and traffic flow, accidents are reduced and public safety is enhanced.

Both the state and local agencies are generally interested in providing the best service to the public. However, budget and staffing constraints make it difficult for agencies to experiment with new methods or technologies. The agencies want to be able to provide these services at the lowest possible costs. Therefore, the performance measures that are established cannot be too time consuming or costly to measure.

Eventually, more winter maintenance agencies will adopt more performance measurement practices. The public will continue to expect clear roads and less harm to the environment from snow ice control operations. Technologies such as AVL, GPS, friction meters, and RWIS, among others, hold the key to obtaining additional data to enhance measuring performance. Expanded use of these technologies will bring down the prices as production and competition increases. Both field personnel and management would have to train to focus more on outcomes when using these more costly technologies.
The objectives selected by each agency can drive performance measurement by creating targets toward which activities can be directed. In addition to objectives, performance measures need to include a short-term result, an improvement strategy, and accountable entities. In addition, success with performance measurement will rely upon the ability to create responsive data systems that generate timely data.

Performance measurement offers a promise of improved management and improved outcomes. It builds on a long history and extensive experience in techniques to strengthen and improve winter maintenance operations. As the winter maintenance community moves toward a future that includes performance measurement, program successes will follow.

SYNTHESIS AND ASSESSMENT

Based on the review of relevant literature and survey of agencies, more than 20 distinct performance measures were identified. For some of the measures, agencies used a variety of approaches to acquire the data to calculate the measures. Within this data set, more than 40 combinations were identified. Our approach was to categorize the various measures as input-, output-, or outcome-based and summarize their frequency of use.

Generally, the data for input and output measures come from the agencies’ accounting systems or maintenance logs. There is not much variation in the approach to acquiring these data. For outcome measures, however, it is more difficult to obtain data, since the majority of outcome measures are based on some form of manual observation. However, some developing technologies in the experimental stages can provide innovative solutions to acquiring outcome measure data.

Additionally, any measure used for time-series analysis would benefit from applying a storm severity index. There is no shortage of options in the literature. The various indices were evaluated based on the availability of data to calculate the index and its usefulness in improving understanding of performance or communicating performance to administrators.

To provide direction for this synthesis and assessment, the study team developed criteria for evaluating measures and the associated approaches to acquiring data. These criteria were applied to screen out measures or approaches that do not exhibit the following characteristics:

- Related to controllable facets of performance
- Reliable
- Understandable
- Timely
- Consistent
- Sensitive to data collection costs
Table 4. Summary of snow and ice control performance measures by category

<table>
<thead>
<tr>
<th>Input measures</th>
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<tbody>
<tr>
<td>Fuel usage</td>
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<tr>
<td>Overtime hours</td>
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<tr>
<td>Personnel hours</td>
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<tr>
<td>Percent of salt spreaders calibrated</td>
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<table>
<thead>
<tr>
<th>Output measures</th>
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</thead>
<tbody>
<tr>
<td>Lane miles plowed</td>
</tr>
<tr>
<td>Tons of material used</td>
</tr>
<tr>
<td>Amount of equipment deployed</td>
</tr>
<tr>
<td>Plow-down miles traveled</td>
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<tr>
<td>Cost per lane mile (efficiency)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to bare pavement</td>
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<tr>
<td>Time to wet pavement</td>
</tr>
<tr>
<td>Time to return to a reasonably near-normal winter condition</td>
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<tr>
<td>Time for traffic volume to return to “normal” after the storm</td>
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<tr>
<td>Time to provide 1 wheel track</td>
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<tr>
<td>Friction</td>
</tr>
<tr>
<td>Level of service</td>
</tr>
<tr>
<td>Travel Speed during storm</td>
</tr>
<tr>
<td>Customer satisfaction</td>
</tr>
<tr>
<td>Crashes per vehicle mile</td>
</tr>
<tr>
<td>Traffic volume during storm</td>
</tr>
</tbody>
</table>

Screening of Approaches

The survey analysis identified 4 input measures, 5 output measures, and 11 outcome measures used by public agencies to measure snow and ice control performance. To identify measures and approaches that warrant further study, the following criteria were applied to the measures and approaches:

Measure criteria
- Does the measure directly measure safety, mobility, or public satisfaction?
- Does the measure improve snow and ice control?
- Is the measure mapped to roadway segments?
- Is the measure reported for garages or districts?
- Is the measure sensitive to storm characteristics?

Approach criteria
- Is the approach quantitative?
- Is the approach stable across observers?
- Is the technology likely to improve?
- Is a major capital or operational investment required?
- Can the approach be “piggy backed” on another system to reduce installation cost?

Applying these criteria revealed that input and output measures are valuable management tools because they measure the amount of material, labor, and money consumed, as well as the amount of material...
applied to roads, lane miles plowed, etc. However, these measures do not directly address the goals of the agencies, which all speak to public safety and maintenance of mobility. As they are, input and output measures help with budgeting and can be used roughly to compare efficiency between garages or districts that experience similar snow and traffic conditions. However, as far as the survey could determine, the measures do not improve snow and ice control but rather track the investment required to do so. The measures are generally not mapped to roadway segments, although they are often reported by garage or by district. Input and output measures are not observed to be sensitive to storm characteristics, although they could be if an index were applied.

Summary of Approaches

In summary, the study team recommends the following:

- Document best practices for manual observation of pavement conditions. Manual observation will clearly be the dominant approach to acquiring winter condition data for a long time, and best practices should, therefore, be shared.
- Document the use of traffic control center cameras or remote cameras to aid manual observation inputs to performance measures.
- Strongly pursue detector-based approaches that use traffic speed, volume, or occupancy as means of acquiring data measuring performance. Also pursue institutional issues regarding data use, technological opportunities, and technological barriers.
- Document measures that are or can be based on friction. (Friction measuring technology will not be evaluated.)
- Document best practices and opportunities for recording and analyzing crash data during winter storms for use as a performance measure.
- From the 15 storm severity indices found in the literature, recommend a reasonable procedure for incorporating an index to normalize input, output, and outcome measures.
- Determine best practices in the measurement of customer satisfaction and link those measures to measures of operational performance.

What Performance Measures Do for an Organization

The accounting firm of Price Waterhouse (Artley and Stroh 2001) has offered three main reasons for establishing metrics in an organization, listed below. These reasons can also be applied to snow and ice control operations.

1. **Measurement clarifies and focuses long-term goals and strategic objectives.** Performance measurement involves comparing actual performance against expectations and setting up targets by which progress toward objectives can be measured.
2. **Measurement provides performance information to stakeholders.** Performance measures are the most effective method for communicating about the success of programs and services. For example, in public education, states and school districts routinely issue report cards highlighting test score outcomes and other key indicators of educational performance. These have become centerpieces of attention among not only educators but many other stakeholders. Snow and ice control agencies can also benefit from report cards regarding their performance.
3. **Measures encourage delegation rather than micromanagement.** Hierarchical structures and extensive oversight requirements can hinder organizational effectiveness. Performance measures free senior executives for more strategic decision making and collective intervention while clarifying the responsibilities and authority of managers down the line.
Benefits of Performance Measurement

Performance measurements offer the following benefits to an organization:

1. **Performance measurement enhances decision making.** The process of developing performance measures allows an agency to determine its mission, set goals for desired results, and identify methods of measuring how well the results are achieved. The data generated through performance measurement can be used to determine program effectiveness, evaluate options for road maintenance, and chart long-term programs and fiscal plans. For upper-level management, performance measures can focus attention on outcomes and can allow for solid evaluation techniques.

2. **Performance measurement improves internal accountability.** Measuring performance gives decision makers a significant tool to achieve accountability. Employees at all levels are accountable to managers for their performance or that of their crew, and upper-level managers are accountable to departmental executives. This relationship becomes much clearer when outcomes and outputs are measured by a commonly accepted standard. Systems such as “management by objectives” or “pay for performance” can be much more effective when teamed with a high-quality measurement system.

3. **Performance measurement supports strategic planning and goal setting.** Without the ability to measure performance and progress, the process of developing strategic plans and goals is less meaningful. While there is clearly some benefit to thinking and planning strategically, the evaluation of such plans and goals cannot be objective without measuring performance and achievement. For example, our literature review found that the Wisconsin Department of Transportation in 1996 implemented its MAP, which used performance measures to achieve its performance-based service levels. These performance measures are based on customer-oriented outcomes or the results of highway winter maintenance operations that highway users are able to identify. The results are collected by field evaluations of highway conditions (Baroga 2004).

Organizational metrics are important for these organizations. Working with employees, management, and affected stakeholders, organizations involved in strategic planning can develop measures of performance in the production of goods and services and in meeting the organization’s most important objectives.

There is no single model or process for developing performance objectives and measures, nor is there a process that will guarantee good results. We have attempted to synthesize lessons learned from the literature as well as the insights gained from our surveys and work with agencies in applying performance measurement to the management of snow and ice control operations issues.

**Applying a Performance Framework or Toolbox**

One method used to develop performance measurements for snow and ice control is to apply a framework or toolbox to the problem. A performance measure toolbox brings structure to performance planning and clarifies the connection between activities, outputs, and results. The toolbox uses the following steps relative to the objectives specified in an agency’s strategic plan:

1. **Confirm snow and ice control operations role.** The rationale here is to determine why the agency is measuring performance. The agency should define the role that snow and ice control operations are intended to play with respect to strategic objectives and should provide a basis for establishing overall targets and performance measures.
2. **Identify the key snow and ice control activities and outputs.** The rationale for this step is to ensure that winter maintenance managers and staff focus on key issues that contribute to the achievement of the department’s strategy for snow and ice control operations.

3. **Identify stakeholders and issues.** The rationale for this step, in order to formulate a set of snow and ice control objectives, is to identify the customers whom the winter maintenance activities and outputs should serve, influence, or target; the other principal groups affected are; and the ways these groups are affected.

4. **Identify what the snow and ice control operations aim to accomplish.** The rationale for this step is to illustrate that the results are defined in terms of outcomes that then become the focus for determining appropriate objectives, milestone targets, and measures, e.g., that managers receive appropriate feedback.

5. **Identify responses and performance requirements.** The rationale for this step is that performance objectives must be defined in operational terms to be managed effectively.

**CONCLUSIONS**

Achieving reliable and relevant performance data for a snow and ice control performance measurement program is a large task for any organization. The challenges and problems associated with performance measurement are multiplied by the unpredictable nature of working with winter weather.

Complex factors influence the usefulness of performance measures. First, the performance measures must be perceived as reliable. Straightforward processes are best suited for obtaining reliable data because complexities can cause variations in reporting. Furthermore, each district or garage should have a clear understanding of what to include and exclude from the performance measurement program. The program should also involve key people in the creation of performance target definitions and in the reexamination of existing definitions and measures.

In addition to reliability, relevance is a key ingredient in data use. As discussed, relevance takes many shapes, and managers and jurisdictions each have their own unique needs. Factors influencing relevance include managerial control, timeliness, fruitfulness, organizational capacity, and the organizational philosophy of performance measures. This is not an exhaustive list, yet it is enough to demonstrate that achieving data use is not effortless.

Agencies may be able to improve their snow and ice control services by measuring the effectiveness of services they provide. Measuring performance, or the results of services, provides several benefits. The results can demonstrate value to taxpayers. Knowing the results of the service allows an agency to tell whether it has accomplished its intended objectives, and, if necessary, adjust its procedures or practices. Concentrating on results also helps agencies be more responsive to the needs of their customers and may help agencies communicate more effectively with taxpayers.

The research revealed the organizational objectives associated with snow and ice control performance measures. These objectives relate to the inputs, outputs, and outcomes of snow and ice control operations as follows:

- Accounting for inputs used for snow and ice control
- Accounting for outputs accomplished
- Operational efficiency
- Meeting outcome goals
Many snow and ice control agencies have not moved beyond collecting performance data to utilizing these data to proactively manage the agency. A successful snow and ice performance program relies on the ability to obtain meaningful data, use these data to manage the program, and institutionalize these practices so that they become routine. Leadership is important to promote understanding and support for the organizational mission, and leadership demonstrates commitment to managing for results. Staff must buy into the program and feel empowerment and continuity. Finally, the results of performance management must be communicated among relevant stakeholders is crucial to the success of any performance measurement or management system.

While performance measurement is beginning to become more common, very few snow and ice control agencies are actively involved in using that data to proactively manage. In other words, performance measurement has not yet become performance management. Careful planning, consistent implementation, and thorough communication will help shift the snow and ice control agency beyond performance data collection to effective performance management.
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