2007 Winter Maintenance Peer Exchange Prioritized Research Needs Statements

Progress Updated to August 5, 2011. Questions or update information can be directed to Lee Smithson, 515-239-1519 or leland.smithson@dot.iowa.gov

group rank	Short title	total votes	# votes	individual rank	Research Needs Statements	Research Group	Progress To Date
1	Guidelines for anti-icing and deicing	191	72	1	How to determine the proper timing and frequency of anti-icing and deicing? This was a discussion on determining when and at what rates deicing materials should be applied to the roadway to maximize effectiveness. Items such as product type, pavement temperature, pavement type, relative humidity, precipitation rate and type, etc. The discussion also recommended a guide for when and how much deicer should be used for reapplication of materials.	Clear Roads	The FHWA TE-28 work has been expanded by the NCHRP6-13 project and reported in NCHRP Report 526. This project tested five strategic/tactic snow and ice control strategies at 51 field sites over three winters. To measure effectiveness a condition index was developed which was used to evaluate both within-event and end-of-event LOS achieved. A treatment design procedure considering precipitation type and trend, cycle time, wheelpath condition, traffic volume, dilution potential, pavement temperature and trend and ice/pavement bond is presented. Details can be found at www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=880. Version 2 of the AASHTO Anti-icing/RWIS CBT distributed in July 2007 contains the results of the 6-13 research. Also work is underway at WTI on additional laboratory and field tests. Project details can be found at www.westerntransportationinstitute.org/research/winter/completed/default.aspx. Also project rank #1 in the 2009 Winter Maintenance Peer Exchange entitled "Develop Level of Service Based Application Anti-icing and Deicing" is addressing some of the same issues as this research needs statement. Results of completed research reported on that research needs has been inconclusive. The underlying science found in the FHWA TE-28 and the NCHRP report 526 are being used to form treatment recommendations for the MDSS and for other states using a proactive approach for snow and ice control and generally yield reasonable results. It appears more comprehensive research will be needed to move beyond the results of those studies. Clear Roads has also completed three studies looking at testing deicing chemicals and also guidelines. See www.clearroads.org/research-projects.html for more detail.
			62	2	Develop anti-icing, deicing and pre-wetting implementation guidelines. The group felt there was a need to develop a standard set of guidelines or “best practices” that covered anti-icing, deicing and prewetting.		
			57	5	Are the FHWA TE-28 anti-icing guidelines accurate, appropriate, effective? The group felt the anti-icing guidelines need to be proven under actual conditions to determine if the application rates are accurate and effective for the different precipitation events and pavement temperatures. The tests were done in the early 1990’s and the group felt with advances in technology it should be possible to test these guidelines to see if they are still valid.		

2	Staffing	129	61	3	Synthesis of unconventional staffing strategies to meet increasing demands. The participants in Track 3 felt government agencies are being downsized but the work load hasn't been reduced. When faced with critical events such as a major winter storm that must be dealt with in a timely manner, an agency may need to implement unconventional staffing strategies to meet these needs. The thought was to perform a literature search and international survey to determine what transportation agencies have done to meet these needs and prepare a synthesis to document staffing strategies. The synthesis should consider both successes and failures and include a variety of storm scenarios.	TRB	There are several NCHRP Projects that address the staffing dilemia. The NCHRP FY 2009 program allocated $350,000 to Project 20-81, "Guide to Implementing Strategies to Attract and Retain a Capable Transportation Workforce" was completed in June 2011. Details for this project can be found on TRB's website http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=2514. Final report can be found at http://www.trb.org/Main/Blurbs/Strategies_to_Attract_and_Retain_a_Capable_Transpo_164747.aspx . Another NCHRP Project that is active from the 2007 program is NCHRP Project 20-72, "Tools to Aid State DOTs in Responding to Workforce Challenges" It is funded at $300,000 and most of the work completed and NCHRP Report 636 has been published. A demonstration website was developed and is being expanded into a prototype web application to be managed by the AASHTO Subcommittee on Personnel and Human Resources. Details of this project can be found at http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=658 The TRB AHD15 Maintenance Personnel Committee has been co-sponsoring four hour sessions entitled "Building the 21 st Century Workforce" at TRB Annual meetings. These four hour sessions have been addressing many of the staffing issues found in this research needs statement. For more details visit the Committee's website at http://webboard.trb.org/default.asp?action=10&boardid=13&fid=761 .
			21	35	Developing Tools for Outreach. The participants in Track 3 felt more needed to be done to reach out to the younger audiences to excite them about careers in transportation. What types of promotional materials are being developed and are they affective? What type of education outreach should be done, i.e. presentations at schools, fairs, etc?		
			15	48	Meeting increasing training challenges. The participants in Track 3 felt the employment pool is changing. There is a lack of work ethic and work skills. New techniques are needed to fill these work skill gaps and instill a good work ethic.		
			27	23	Synthesis of strategies of retaining trained personnel. The participants in Track 3 felt agencies are losing valuable trained and experienced personnel to other agencies and contractors. More needs to be understood about how to keep these people from going elsewhere to work. Exit interviews need to examine why people are terminating employment and what could be done to make their job more attractive.		
			5	65	Synthesis of innovative methods to compete with industry. The participants in Track 3 felt a synthesis needs to be prepared to illustrate innovative ways that government can compete with private sector salaries and benefits. Ways need to be developed to overcome the stigma that government jobs are of lesser value that private sector jobs. Also examine government processes for hiring, do they need to be streamlined to avoid unnecessary delays and other time consuming seemingly bureaucratic delays.		

3	LOS determination	117	18	40	Road prioritization formula for winter maintenance LOS	TRB	NCHRP 20-74A "Development of Service Levels for the Interstate Highway System" is under contract with a contract period completion scheduled for 9/30/2010. The objectives of this research are to develop a standard way to describe the service level of Interstate Highway System assets and a process that agencies can use to prepare a template for describing service levels. Service levels and their indicators would be uniformly defined for the Interstate System as a whole, but service-level measures (how indicators are consistently assessed) could vary from on state to another. The results of the research would be utilized by agencies for assessing and benchmarking the performance of their Interstate Highways. Complete project description and progress can be found at www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=1638. Results have been published as NCHRP Report 677. Also an I-80 Corridor Coalition has been formed and had three meetings (Kick off meeting January 26-27, 2010, a webinar on June 8, 2010 and a Fall Conference on October 26-27, 2010. The Coalition is surveying many of the Western States to see what information is currently being used so that an agreement among coalition states can be made as to level of service and road descriptors to be used. Their website is www.i80coalition.com . This topic is also addressed in AURORA 2010-03, Results Based Winter Road Maintenance Standards, www.aurora-program.org/projects.cfm, a 3 year project that is in its first year.
			5	67	Case studies on ensuring consistency in winter maintenance practice across state borders		
			8	58	Establish seamless boundaries for winter information across states		
			34	13	Is there a defensive way to determine or establish LOS nation wide (corridor management and seamless LOS across state boundaries)? Develop a national LOS to better transition motorists across boundaries without sudden change in conditions. (Similar to 19). Consistency across state lines is a challenge. This would document successful practices some states have worked out which would help other states gain from these experiences		
			17	42	Is there a defensive way to determine or establish LOS nationwide (corridor management and seamless LOS across state boundaries?		
			5	64	FHWA develop pilot/demonstration projects for seamless winter operations (NCHRP 20-74A problem statement). The FHWA should develop pilot or demonstration projects of seamless winter operations. This would include LOS, winter messages, RWIS, and other technologies. The results of the pilots can be used to establish and/or revise standards and policies.		
			30	19	Determining an appropriate wintertime LOS for specific areas. Develop a road prioritization formula to determine LOS and see if it can be used nationwide		
4	Funding	109	40	8	Determine staffing and funding for core maintenance activities. The group felt strongly about determining the staffing and funding needed to support the core maintenance activities. Privatization, outsourcing and downsizing has impacted the DOT's ability to adequately perform core maintenance activities (summer and winter). Flexible workforce has helped address needs of winter maintenance but doesn't address the summer needs. Summer crews are under staffed and unable to perform some maintenance function because of lack of resources.	TRB	This funding project was discussed at the combined Aurora and SICOP meeting in December 2007. It was decided that TRB was the appropriate lead for this project. John Burkhardt attended the TRB Maintenance Operations and Management Committee January 2008 meeting in Washington DC and discussed how this project fit that committees scope, "This Committee is concerned with all aspets of managing the maintenance and operations of highway transportation facilities". The committee agreed and prepared a research problem statement entitled, "Relationship Between Maintenance Cost and Level of Service" which addresses most of the elements in the three research needs statements listed in the column to the left. Also NCHRP 14-18, "Determining Highway Maintenance Costs" will feed into this project. The project is finished and NCHRP Report 688 published. More details can be found at www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=1633. This topic is also addressed in AURORA 2010-03 which includes models of the safety and mobility benefits associated with different service levels for winter maintenance. It is also addressed in a Research Problem Statement titled, "Applying Asset Management Principles to Winter Maintenance" that was submitted for consideration in the NCHRP FY 2011 program, but was not selected for funding.
			43	6	Identify long-term impacts of not funding maintenance fully for summer and winter activities. The group felt that the impacts of not funding maintenance activities fully would come back and bite us in the future and the cost to replace these system would be much more expensive. The research initiative would identify the maintenance activities that have been eliminated or reduced due to resource reduction and quantify the long term impacts on department and system to raise awareness and support.		
			26	24	How do we establish appropriate dedicated funding levels for maintenance? Several state indicated ways they had worked with upper management, legislature, etc. to secure appropriate funding for maintenance. These methods should be examined and documented and the results shared with other states.		
5	Communication with public and legislators	105	39	9	Develop tools to manage and communicate LOS, expectations and costs associated to urban, sub-urban and rural routes. DOT's need tools to be developed to assist them in managing and communicating with motorists, management, politicians, stakeholders etc. They need effective ways to communicate and explain level of service, expectations, and costs on various roadway systems.	SICOP	Followup has been made with AASHTO's Director of Communications and Publications and were advised that the AASHTO Public Affairs Committee has embarked on a marketing effort to heighten the awareness in both the legislative and the public sector about all that DOTs do. Further coordination is being accomplished to ensure the importance of winter maintenance is included in this marketing effort. An active and effective liaison between the AASHTO Highway Subcommittee on Maintenance, Highway Safety and Reliability Technical Working Group and the AASHTO Subcommittee on Public Affairs is being established with emphasis areas "reliable all weather mobility", "the importance of transportation to our social and economic well-being", "and the need for adequate funding". This topic is also addressed in a NCHRP Research Problem Statement title "Applying Asset Management Principles to Winter Maintenance" that was submitted for funding in the FY 2011 program, but was not selected. A NCHRP project now underway that will relate to this RNS is NCHRP Project 14-24, "Guidance for Communicating the Value of Highway System Maintenance and Preservation". Progress can be followed on http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2969 .
			18	41	Best practices for balancing politics and performance. The participants in Track 3 felt that a literature search needs to be done and probably a survey to determine what are the best practices for communicating to legislators the need to establish performance measures and then provide the staffing and funding necessary to meet those measures. There is also a need to be able to communicate performance metrics to field crews so they understand their importance.		
			12	50	Synthesis of how to effectively relay and communicate winter maintenance budget's needs to upper management and legislature. Develop successful communication strategies to inform, educate and communicate funding maintenance needs to upper management and legislature to ensure adequate funding. They also need to understand the ramifications of not funding maintenance activities and the long term impacts on the infrastructure.		
			19	37	How to most effectively communicate performance measures and associated costs to internal staff, operators and stakeholders. (Same as 9).		
			17	43	Inform stakeholders of the critical activities and impacts of maintenance on daily lives. The image of maintenance workers is two fold – snowfighters in the winter and slugs in the summer (standing around doing nothing). The image of the maintenance worker needs to be improved. The critical activities of maintenance need to be explained to the public so they understand the how impact their daily lives.		

6	Vehicle to Center communications	89	35	12	Seamless wireless communication for transferring data from vehicle to maintenance garage. The scope of this discussion was to develop a standard communication protocol that could be used to move data between systems in a truck and back to a data collection system. I think this was more about developing a set of national standards for data exchange with snowplows that would allow states to use non-proprietary software and hardware to collect data from trucks. Plug and Play technology for snowplows with better integration of existing and new equipment	Clear Roads	This topic was addressed by the Clear Roads research project entitled "Development of Interface Specifications for Mobile Data Platforms on DOT Vehicles." For more information on this project and the final report visit the Clear Roads website at http://www.clearroads.org/research-projects/08-02interfacespecifications.html. Additional national efforts underway on seamless wireless communication and real time data communications can be found at www.deploy511.org/coalition.htm, click on "Intellidrive Connectivity-Mobility" and "511 for the CVO Community".
			25	29	Development of standards for in-vehicle equipment. Can be combined with 12. States cited problems interfacing new or existing spreader or sensor equipment with each other. Need standards so you can be sure that one system will work with the other.		
			8	62	Innovative solutions for real-time vehicle-to-center data communications. Need to collect or research different solutions to get vehicle data into the department's network or web. Often what works best for one person or area will not work for another so we need pros and cons for many methods. Need low-cost and relatively easy solutions. Communication costs can be quite substantial for equipping a whole fleet so an agency must be able to choose wisely from its available options.		
			21	34	Develop standard specifications for components and communications. To allow plug-and-play to minimize incompatibility of hardware and software and minimize training. Need to work closely with vendors. Could be continuous partnership. e.g. standard specs for GPS/AVL. (Same as 12)		

7	Performance measurement	87	59	4	Develop standardized performance measure for snow and ice. The states were all over the board with performance measure for winter maintenance. There was a need to standard the performance measure so that a roadway classification was consistently set across the US. Motorist traveling across state boundaries experienced the same level of service of interstate system.	TRB and SICOP	The National Cooperative Highway Research Program made limited distribution of NCHRP 6-17, "Performance Measures for Snow and Ice Control Operations". Further details are available at website www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=884. A power point on the project and other performance measures presentations made at the 2nd National MQA Peer Exchange held on September 23-24, 2008 covering best method practices can be found at the website http://www,rutc.org/outreach/mqa. AASHTO completed a computer-based training program containing the results of the NCHRP project plus other experience from state DOTs. The CBT was distributed in May 2010 to all state DOTs participating in the pooled fund used to develop the CBT. Additional information on the CBT can be found at www.transportation.org/sites/sicop/docs/CBT_Flyer_v2b%5B1%5D.pdf . This topic is also addressed in AURORA 2010-03, Development of Output and Outcome Models for End-results, a 3 year project that is in its first year. AURORA Project 2004-04, Winter Weather Severity Index Enhancements, (now completed) developed a Winter Severity Index applicable to any state. Leveraging the work of Iowa Highway Research Board Report TR-491, "Performance Measurement of Highway Maintenance Operations" (Qui & Nixon, 2009), the Iowa DOT has devised a way to predict or simulate the drop in average traffic speed at a given time using commonly reported and forecast Road Weather System (RWIS) data. They propose to quantify the quality of winter maintenance at any given time by comparing the simulated traffic speed to the traffic speeds observed by traffic speed sensors and GPS products. The minute-by-minute nature of the traffic comparisons makes it easier to evaluate the specific events surrounding all of the micro-event successes or failures over the course of a winter storm, including crew deployments, material usage, and changes in weather conditions. The Iowa DOT is working with Iowa State University's Statistics Department to fine-tune the traffic algorithms and will be working with a third-party developer to build a performance analysis GUI for maintenance staff to compute, view, and summarize their winter maintenance performance and effectiveness of various techniques.
			20	36	Develop a state winter severity index as a tool to compare materials use and costs (MnDOT, Washington DOT, New Hampshire) Evaluate the winter severity index tools currently be used by states. The group felt that a uniform and consistent winter severity index needed to be established so that states could normalize performance and costs.		
			8	59	Feedback of customers' expectations on winter maintenance. Several states use customer feedback as a way to manage and determine their targets and performance measures. A synthesis of the different methods used should be documented and evaluated. The most effective approaches should be summarized so that states can more effective manage customer expectations of maintenance activities.		
8	Weather and RWIS education	81	28	20	Better use of RWIS and weather forecasts for decision making. Develop more training on how to use RWIS and weather forecasting to help decision making. Improvements also need to be done to the RWIS for a more accurate chloride sensor for integration into the decision making process. There seems to be a lack of understanding on the correct action to take based on weather conditions and forecasts.	Aurora	Aurora has funded Project 2009-04, "Road Weather Education Enhancements and Dissemination" in the amount of $20,000 for FY 2009. The objective of the project is to develop methods and/or materials to disseminate existing road weather and RWIS educational materials. A project meeting was held April 13, 2010 and available training materials are being gathered and reviewed for posting. Progress on the project can be found on www.aurora-program.org/projectdetail.cfm?projectID=65 . AURORA funded project 2008-03, MDSS Demonstration in Ontario, that is in progress to demonstrate and evaluate decision-support tools for winter operations and for setting spring load restriction dates. AURORA project 2003-05, Investigation of the Variability of Snow Cover Conditions, developed tools for documenting and understanding local variations in snow conditions along a maintenance route, using continuous friction measurements. The additional training called for in the RNS has now been developed. See the AASHTO CBT entitled "Anti-icing/RWIS" and specifically Lessons 4, 5, 6 and 7 in the CBT, see website http://www.transportation.org/?siteid=88&pageid=2173 and click on "CBT Handout". FHWA as part of the development and field testing of MDSS had forecasters visit field sites to observe field operations and obtain a better understanding of how forecast are used. Most VAMS contracts now have provision for field operations personnel to communicate directly with forecasters when they need clarification, feel the forecast isn't accurate or the forecast doesn't fit local conditions. This communication helps both field and forecaster "speak our language". More information is posted on the FHWA Road Weather Management website at www.ops.fhwa.dot.gov/weather/resources/publications.htm.
			9	56	Educating meteorological community about the maintenance personnel's weather information needs. The group felt that there needs to be more meteorologists who understand the needs of maintenance personnel. Need to develop a way to educate more forecasters about what maintenance needs in a forecast and how to 'speak our language'.		
			7	63	Develop plan for improving weather forecasts through outreach to meteorological community. DOT folks need to know what they can do to help make their forecasts better – i.e., do meteorologists need better RWIS, different types of sensors? What do they need from us? Are they getting it?		
			16	47	Training for maintenance personnel to interpret forecasts. Forecasts may contain a lot of information that can be easy to misinterpret. Additionally, forecasts often contain information that is missed (clues to tell when a forecast is already off to a bad start, forecast details like wind or relative humidity that can really make a difference to maintenance, etc.) Need more training on not just the weather info in the forecast, but also 'reading between the lines'.		
			19	39	Training for how to use technologies (e.g. RWIS, in-vehicle pavement sensors). The group discussed how lots of maintenance folks are not as RWIS sensor-savvy as they should be. For example, the differences one can expect between in-pavement and infrared road temperature sensor readings under certain conditions.		
			2	69	Education about microclimates. Weather can change dramatically in small areas. Local weather quirks are often well-known in the heads of veteran vehicle operators and supervisors, but new employees are at a disadvantage. This project would investigate ways of using technology to "record" the ways that veteran personnel respond to microclimates so if the veteran retires or otherwise not around, the new employee (or the one who is just from a different area) is armed with much the same knowledge.		

9	Salinity sensor	79	33	17	Develop on-vehicle salinity sensor People wanted to know how much salt was on the road so they could track dilution, re-freeze potential, and how much more chemical (if any) should be applied at that time.	Aurora	Aurora has funded Project 2009-06, "Salinity Sensor Improvements and Development" at $50,000 in FY 2009. The objective of this project is to survey state transportation agencies to gauge interest in purchasing and utilizing on-vehicle chemical sensors, and if so, how many and at what price. This project came up as an unmet research need in the 2009 Peer Exchange and is listed on that spread sheet as "Rank 12". An on-vehicle salinity sensor was developed and worked successfully on the Highway Maintenance Concept Vehicle. Details can be found in the "Highway Maintenance Concept Vehicle, Final Report: Phase Four" June 2002, pages 43-54, www.intrans.iastate.edu/reports/concept4.pdf. Clear Roads would be a likely partner on future reseach.
			34	14	Best way to measure the chloride content on the surface and determine how long they last. The group was interested in a real-time feedback of chloride levels and expected time period the chemical could maintain the roadway. The discussion focused on roadside and vehicle mounted sensors along with work in the laboratory. The research can focus on evaluating the accuracy and reliability of devices and their relative performance when dealing with different deicers which would be beneficial for the success of MDSS.		
			12	52	Improved chemical sensor. Need a better in-pavement chemical sensor that can reliably tell how much chemical is still out on the road. Current sensors do not seem reliable enough to base decisions.		
10	Light precip forecasting and sensing	76	42	7	Improvements in sensing and forecasting of ice, freezing rain and frost conditions. This project was suggested because of discussions regarding how hard it is to detect freezing drizzle on radar and common RWIS equipment. Hand-in-hand were issues with freezing rain forecasts, the rain/snow line, and frost forecasts. They observed that sometimes the first indication of any freezing drizzle in the area was a call from the state patrol or your neighboring garage and that is not acceptable.	Aurora	A project manager has been assigned to this project and a project meeting was held in September 2008. The status of the project can be tracked on the Aurora web site as Project 2007-04: "Development and Demonstration of a Freezing Drizzle Algorithm for ESS". Phase 1 began in December 2007. For more details: www.aurora-program.org/projectdetail.cfm?projectID=56 .
			26	26	Developing improved precipitation sensor. Need an RWIS precipitation sensor that is very reliable and can at least do precipitation Yes/No. Precipitation type and rate are desirable as well. Strong emphasis on its ability to sense (at least yes/no) all types of precipitation reliably and ability to live in a roadside environment without frequent maintenance. Sensor needs to be relatively cheap.		
			8	61	Improvements in forecasting of low-elevation weather conditions. Similar to 7, improvements need to be made in forecasting fog, freezing fog, drizzle, and things which otherwise slip under radar and are hard to monitor and forecast.		
11	Concept Vehicle	71	36	11	Developing the next generation concept vehicle and optimized plow design. The group felt there was a strong need to continue focusing on new technologies for equipment (robotics, GPS/AVL, zero velocity spreaders and plow design that would allow operations to be more efficient and effective in the future. The group sensed the work that was done in SHRP and with previous concept vehicle projects was great but wanted to see a national push for developing the next generation snow plow.	Clear Roads	Clear Roads is working with the Winter Concept Vehicle Pooled Fund to conduct research on optimum snowplow design. The primary objectives of the research project have been efficient snow removal, driver safety and comfort, and improved financial efficiency. The goal was to develop a different type of snowplow blade with multiple edges that will eliminate as much snow and ice as possible in a single pass. A final report is nearing completion. More information on this project is available on the website at: http://clearroads.org/partnershipprojects.html.
			22	31	Optimizing the ergonomics for snowplow operators. Determine if the new technologies, equipment changes or multi-tasking requirements are taxing equipment operators. Investigate the physical characteristics needed in the cab of a snowplow to provide safety and comfort for operators plowing for long periods of time. Also discussed was determining the ideal lighting for a snowplow to see and be seen by the traveling public and how to keep the rear of a plow clean during plowing operations.		
			13	49	Optimization of the in-vehicle driver interface. Drivers need certain information to help them make appropriate treatment decisions but Information overload can be harmful. What information should be presented? How should this information be presented?		

12	Post storm meetings	59	32	18	The importance of post storm meetings. The participants in Track 3 felt that the importance of post storm meetings was not recognized by many governmental agencies. A literature search needs to be accomplished and results analyzed to learn what type of information is most valuable to document and share. A survey needs to be conducted to determine what is working, how to learn from mistakes, do post storm meetings improve morale, and have the benefits of post storm meetings been quantified.	Clear Roads	Wisconsin DOT Research completed a Transportation Synthesis Report on current practices, which Clear Roads has posted on the Clear Roads web site at http://www.clearroads.org/synthesis-reports.html.
			27	21	Best practices in winter maintenance performance (e.g. post storm assessment). The participants in Track 3 felt more needed to be understood about balancing politics and performance. What are some best practices in communicating with legislators? What performance metrics seem too meaningful and how to communicate these metrics to the crews. Post storm assessment is also covered in #18 above. Each state has developed best practices in winter maintenance to improve performance. One example was post storm assessment. These winter maintenance best practices need to be compiled and distributed to states so that they continue to improve winter operators.		
13	Field Testing	58	37	10	Build a test facility to provide objective data regarding the effectiveness of various winter maintenance treatments. The group felt there was a strong need for a national test facility that could be used for testing materials, methods and equipment used in winter maintenance. Having a national test center would establish a rigid set of research guidelines, protocols and procedures which should make the results more accurate. Can also test RWIS sensors and MDSS logic at this facility.	SICOP	The Aurora Consortium has developed a WIKI process which can be used to help researchers find appropriate facilities. Progress on that project can be found at www.aurora-program.org/projectdetail.cfm?projectID=66 . Also the Western Transportation has developed a winter maintenance testing facility called TRANSCEND at Lewiston, Montana. More details are available at http://www.transcendlab.org/ .
			9	57	Pursue objective testing to verify the effectiveness of innovative maintenance treatments		
			12	51	Standardized tests for winter maintenance equipment. May be accelerated lab tests coupled with field evaluation of various brands so that it can be used to determine their service life as an input to the cost-benefit analysis or for side-by-side comparison.		
14	Chemicals and Refreeze	47	22	30	Can chemical blends cause slippery and refreezing? This focus on “blends” of different deicers. How they might interact to complicate the application and re-application rates/timing and resulting deicing/anti-icing performance. Also discussed optimum pre-wetting rate when use liquid deicer to prewet solid deicer. This effort should include conducting extensive lab and field tests on different deicing products to determine under what conditions the product caused slipperiness on the roadway surface and then determine optimum application rates for prewetting and anti-icing.	PNS	The PNS ranked this item as No. 3 for action. Consideration of a member state taking the lead for a research pool fund study being utilized rather than PNS funding since those funds are limited due to other ongoing research. Other on-going research that will add knowledge to this research needs statement include "Testing Methodology for Performance Characteristics and Friction Coefficient of Deicing and Anti-icing Chemicals" being conducted by Western Transportation Institue. See http://www/westerntransportationinstitute.org/research/4W3026.aspx .
			17	44	Investigate what factors influence refreezing on the road. Investigate all the various factors that may cause refreezing on the roadway in the lab and field, such as weather, previous application, pavement type/structure, product type, application rate, pavement temperature, air temperature, humidity, etc. Can be a different topic than 30.		
			8	60	Can the road surface refreeze due to over application of salt? More research needs to be done to determine under what condition salt may refreeze on the roadway surface We talked about the right side of a typical phase diagram would imply that the road surface could refreeze due to over application of salt. Needs laboratory investigation and maybe some easy-to-use rules to help practitioners properly use phase diagrams.		

15	Consistent descriptions of road conditions	43	22	32	Develop standard ratings and descriptors for road conditions. Road condition reports vary greatly from one area to another. Also, the interpretation of a given road condition is different to different people. The road itself also can have different conditions along a given road segment. It was felt that we need a standard way of reporting to help bridge these gaps.	SICOP	Progress on this research needs statement has been slow but is moving ahead. Jim Wright, Director, National 511 Coalition, addressed the AASHTO Highway Subcommittee on Maintenance at their annual meeting in July 2008. The 511 Coalition recognizes the lack of consistency and is asking for any help the states can provide in addressing the problem. An "I-80 Coalition" of western states (CA,NV,UT, and WY) was formed in 2009 "To provide better and more comprehensive I-80 corridor condidtions information to both transportation agencies and travelers". Their expectations are to provide consistent traveler information and similar levels of service to achieve a higher degree of boundary transparency and improved mobility, as seen by the traveling public. The I-80 Coalition met three times in 2010. More detail is available at their website www.i80coalition.com and www.deploy511.org/coalition.htm . Progress in achieving consistent descriptions of road conditions in Canada moved forward at the Transportation of Canada Annual meeting on September 25, 2010 when the Chief Engineers of the Provinces Ministry of Transportation approved two reports, "TAC Road Condition Vocabulary Study, Phase I Final Report" and "Transportation Association of Canada Winter Vocabulary User Guide". It is anticipated these two reports will serve as foundational material for consideration in the United States, starting with the I-80 Coalition.
			21	33	Develop acceptable dynamic messages for snow and ice. The group felt that common, consistent and uniform snow and ice messages should be developed for the US. There was concern and confusion over how to present winter messages without generating liability issues.		
16	Cost Benefit for equipment	38	33	16	Cost-benefit analysis of winter maintenance equipment purchases and upgrades. Develop a standard method to measure the cost/benefit of adding different components like wings, guidance systems, GPS, additional sensors, etc. and determining the expected service life of the new equipment.	Clear Roads	This topic is addressed by the current Clear Roads research project titled "Development of a toolkit for cost-benefit analysis of specific winter maintenance practices, equipment and operations." For more information, please go the the Clear Roads website at: http://www.clearroads.org/08-02costbenefitanalysis.html. Also NCHRP 13-03 "Decision Making for Outsourcing and Privatization of Vehicle and Equipment Fleet Maintenance" is developing an evaluation process which considers fleet size and mix, cost effectiveness, performance criteria (preventive maintenance compliance, response time, down time, repeat repairs, etc), quality control, quality assurance, emerging technologies, direct costs, indirect costs, etc. Phase I of this two phase research project has been completed. Phase I of the research effort recommends a process for making decisions on outsourcing and privatization of vehicle and equipment fleet maintenance. It included a review of information relevant to the practices and use of outsourcing and privatization of vehicle and equipment fleet maintenance; identification and evaluation of outsourcing and pr9ivatization practices and procedures, recommendation of certain practices and procedures for further consideration in the research, and presentation of a plan for developing a process for making decisions on outsourcing and privatization of vehicle and equipment fleet maintenance. Phase II of the reserch effort will be conducted under NCHRP Project 13-03A. More details can be found at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=368.
			5	66	What is the true cost of a data collection system (e.g. AVL)? How much does it cost to get a maintenance data collection system – communication, maintenance, operator time, and equipment? Also, what is the payback? Estimating costs can be hard to do and we need more guidance before we jump in.		
17	Training	38	28	28	State-of-the-Practice for using driver simulators as a training tool. The participants in Track 3 felt driver simulators seem to be an attractive training tool. Since they are very costly, management wants to know the payoff for the investment. Can results be measured? How are agencies that have simulators implementing them into their training programs? How do they staff this effort?	Clear Roads	Wisconsin DOT Research has done a Transportation Synthesis Report titled "Vitual Snowplow Training: State of the Practice and Recent Research" which is available via the Clear Roads web site at http://clearroads.org/tsrsnowplowsimulation.pdf.
			10	53	Developing methodologies for evaluating training efforts. The participants in Track 3 felt methods need to be developed to determine if training does make a difference and how this difference can be measured.		

18	Peer Exchange	34	34	15	Support more meetings similar to this one for peer exchange.	SICOP	Future National Peer Exchanges were discussed at 2008 Aurora and Clear Roads meetings. There was strong support for a 2009 Exchange. AASHTO contracted for meeting rooms, lodging and meals at the Sheridan Madison Hotel in Madison, WI and the Second Peer Exchange was held on August 25-26, 2009. Attendees at the 2009 Peer Exchange requested a third exchange be held in about two years. A planning committee has been formed and the next Winter Maintenance Peer Exchange has been scheduled for September 20-22, 2011 at the Best Western GranTree Inn in Bozeman, Montana. A website for the 2007 and 2009 Peer Exchanges can be found at www.westerntransportationinstitute.org/professionaldevelopment/peer-exchange/.
19	Environmental	28	9	55	Develop guidelines for BMPS to achieve attainment in areas of concern. As our groundwater, lakes, and rivers are tested and designated attainment areas, we need to develop guidelines for agencies to effectively manage these areas. What methods are being utilized by other states to meet BMPs and how best to achieve these goals without compromising safety and mobility of motoring public.	PNS	The PNS ranked this item as No. 2 for action. Further group discussion will be conducted in the fall meeting. Consideration of a member state taking the lead for a research pool fund study being utilized rather than PNS funding since those funds are limited due to ongoing research.
			19	38	Need a tool to provide or ensure funding is available to cover salt/sand stockpiles and secondary containments for liquids. Several states still struggle with meeting the requirement to cover salt/sand stockpiles and provide secondary containments for liquid chemicals. They felt that dedicated funding should be secured to ensure compliance with these environmental requirements.		
20	Reducing Corrosion	27	27	22	Synthesis of best practices for reducing corrosion on winter maintenance equipment. Synthesis to include investigation of better designs, use of corrosion resistant materials, coatings, stainless steel, etc. Cost/benefit analysis would need to be included to make sure the practice is cost effective.	PNS	The PNS ranked this item as No. 1 for action. Further group discussion will be conducted in the fall meeting. Consideration of a member state taking the lead for a research pool fund study being utilized rather than PNS funding since those funds are limited due to ongoing research.
21	Blade Inserts	26	26	25	Investigate alternative blade inserts. Investigate alternate blade inserts such as taller carbides, ceramics but also look at alternative methods to clear the roadway with one pass. Also of interest is a way to evaluate and compare different models of blades to determine their wear.	Clear Roads	Aspects of this topic have been addressed by the current Clear Roads research project titled "Development of Standardized Test Procedures for Carbide Insert Snowplow Blade Wear". More information on this project is available at http://clearroads.org/07-01carbideinsert.html. More research is likely needed to be more comprehensive.
22	Cheap Friction	25	25	27	Pilot evaluation of virtual pavement sensors and on-board friction devices. Develop low-cost, simple friction measuring device or other method to determine slipperiness of roadway surface and transmit that information to users to assist in decision making.	Aurora	The Aurora Project 2007-02, "Cold Weather Testing of Halliday Unit" is nearing completion and a final report will be forthcoming. More information can be found on www.aurora-program.org/projectdetail.cfm?projectID=54. Also technical papers on the role of surface friction in winter maintenance can be found in the TRB Circular E-C126, pages 381-416, website www.trb.org/news/blurb_detail.asp?id=9165. Aurora has also funded FY 2009 Project 2009-07, entitled “Review of Friction Detection Technologies” which will review the state-of-the-art in friction detection. In the FY 2010 program, the Project 2009-07 was rolled into new project, Project 2010-03, "Development of Output and Outcome Models for En-results Based Winter Road Maintenance Standards" now in progress at the Ontario Ministry of Transportation and the University of Waterloo.
23	Collision Avoidance	17	17	45	Investigate collision avoidance systems for snowplows. Synthesis of work done in this field that would include investigation of the alert (lights, audible alarms, motion, etc.)	Clear Roads	Wisconsin DOT Research is planning to do a Transportation Synthesis Report on current practices, which Clear Roads will make available via the Clear Roads web site at http://www.clearroads.org.
24	High-def imaging/sensing of road conditions	17	17	46	Explore use of highly detailed satellite imagery in winter maintenance operations. The goal of this statement is a way to remotely monitor the condition of a road along its full length – not just at certain points like most in-situ sensors do. Something that can be presented visually, like high-detail satellite imagery is optimal.	Aurora	This project was discussed at the May 2008 Aurora meeting. The project has been placed on a list to consider in future programming beyond 2009.
25	Forecast accuracy	10	10	54	Developing measures of forecast accuracy. Need a good way to tell how accurate different forecast sources are. This would be used to monitor forecast services and keep track of which sources do the best when you have more than one to look at. Also it can be used to test whether complaints about a new forecaster are real or just because it’s new. What is the most accepted way to gather or use observations as ‘truth’?	Aurora	Aurora has one ongoing project 2000-01, "Benchmarking the Performance of RWIS Forecasts". See their website at www.aurora-program.org for further details. Aurora will track this project for any technology gaps that need to be addressed.

26	Boilerplate legal language	4	4	68	Boilerplate language for data sharing Concerns over litigation have slowed down the ability of states to share data. This project would develop some standard language that could serve as a starting point for states to address legal issues that may be involved with data sharing. Also nice to know what language is out there and how it has worked for those who put it out.	SICOP	The FHWA Clarus project uses the following "boiler plate language" which would be adequate to guide agencies needed this type of language "The Clarus System is an experimental product and is being used for evaluation and domonstration purposes only. This is provided as a public service. No warranties on accuracy of data are intended or provided." The National Conference of State Legislatures in 2010 published a report entitled "Weather or Not? State Liability and Road Weather Information Systems (RWIS)". This report begins with an overview of RWIS technologies and their current use, specific RWIS-related liability concerns and closes with a list of strategic options available to DOT personnel and legislators to help reduce the state's liability exposure related to RWIS use. This report can be downloaded from http://www.ncsl.org/?tabid=20241 . This research needs project is considered complete.
27	Snowfences	2	2	70	Best practices for snow fences -- when to use live fences, cost benefit considerations, gidelines for various types of live snow fences (grasses, corn), and understanding political challenges (e.g. killing nice grass before planting natives which look like weeds at first) and dealing with landowners	Clear Roads	Clear Roads supported the efforts of the AASHTO Snow and Ice Pooled Fund Cooperative Program (SICOP) with the development of the CBT module "Mitigating Blowing Snow".http://www.transportation.org/?siteid=88&pageid=2173 This CBT was finished and distributed to the pooled fund states and is available for purchase in the APWA Bookstore.