

MINNESOTA DEPARTMENT OF TRANSPORTATION'S MAINTENANCE OPERATIONS RESEARCH PROGRAM

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ABSTRACT

Minnesota Department of Transportation (Mn/DOT) has supported an active Maintenance Operations Research Program since 1990. This program seeks to develop the most effective maintenance procedures, materials and equipment, and focuses on "on-the-road" or applied research evaluating projects under actual field conditions with state personnel, academia, private vendors and various combinations conducting the research.

From local and state perspective, Mn/DOT's Circuit Rider Technology Transfer Program has proven to be a very effective way to transfer road maintenance technology internally and between the different interests. This program is a partnership between Mn/DOT, University of Minnesota, Minnesota Local Road Research Board and Federal Highway Administration. Three part-time facilitators conduct interactive maintenance-related workshops at maintenance facilities throughout Minnesota and gather technology developed in the field to share it with other local and state workers.

Typical of the program's summer-related research is evaluating new technology for repairing cracks and potholes such as slurry seal patching and micro surfacing. Other research focuses on issues such as vegetation growth control to reduce mowing needs. Winter maintenance research includes such issues as de-icing, anti-icing, continuous friction measuring, zero-velocity spreading and automated bridge deicing systems. Maintenance management research includes the development of a variety of systems such as a statewide maintenance management system, pavement marking systems, thermal mapping, weather reporting, bar-coding, automated call-out systems and automated route planning systems.

This research program is considered to have provided a substantial return on research program investment. Savings in salt and sand use alone with the newly implemented deicing systems practically offset the annual cost of the program.

PROGRAM HISTORY

The Minnesota Department of Transportation's (Mn/DOT) Office of Maintenance has supported a Maintenance Operations Research Program since 1990. It

is managed by the Maintenance Operations Research Engineer (MORE) with program oversight by the Area Maintenance Engineers who finance the research program directly from their operating fund. The new technology and methods for maintenance operations created through the program are seen as a way to optimize resources. This is seen necessary since despite the shrinking work force and budget, the traveling public continues to expect the same or even a better level of service. Having such an operating unit within Mn/DOT that both funds and administers its own applied research initiative is considered unique both nationally and internationally.

PROGRAM GOALS

The goal of the Maintenance Operations Research Program is to involve maintenance areas throughout the state in research projects that address all elements of maintenance operations including snow and ice control technology, pavement, roadside and bridge maintenance, buildings & grounds maintenance, work zone safety as well as technology transfer. The research program focuses on "on-the-road" or applied research taking developed methods, materials, products or prototypes out on the road and field testing them in a structured manner under actual environmental, weather, traffic and other conditions. The program seeks to develop the most effective maintenance procedures, materials, and equipment and to build on research conducted or supported by other agencies and states, the Federal Highway Administration (FHWA), academia, other countries, and private industry.

Research is conducted by different investigating entities depending on the nature and complexity of a particular project. Principal investigators include state maintenance personnel at the truck stations, and university faculty as well as private vendors working alone or in concert with Mn/DOT's maintenance and/or materials research laboratory personnel. The object is for the state or individual maintenance areas to implement successful processes and methods, as well as to acquire and use any equipment or material developed through this research. One of the key thrusts of the program's research efforts is to move from reactive to preventive maintenance.

TECHNOLOGY TRANSFER

An important aspect of the program is to transfer the new technology to potential users once it's developed. Methods used to facilitate technology transfer to implement good ideas and new innovations in equipment, materials, and methods include publications such as the Annual Research Reports [1, 2, 3], One-Pagers [4], video tapes, as well as the technology fair held in conjunction with the annual statewide rodeo. Also, presentations by project sponsors and MORE staff are given regularly at various meetings and conferences, such as in the first annual Maintenance Research Conference held in April 1996.

Circuit Rider Technology Transfer Program

Minnesota's Circuit Rider Technology Transfer Program is currently being coordinated through the Maintenance Operations Research Unit while being a partnership between the Mn/DOT, the University of Minnesota's Center for Transportation Studies (CTS), the Minnesota Local Road Research Board (LRRB) and the FHWA. As of March 1996 there are three part-time facilitators working with the Circuit Rider Program making presentations and putting together interactive workshops throughout the state. They visit both Mn/DOT field offices as well as local government agencies exchanging highway maintenance technology between state maintenance workers and between the state and local units of government, "downloading" research results in order to get the best return for investment made towards research in Mn/DOT and elsewhere.

This quickly expanding program involves field visits on a scheduled or as-called basis to Mn/DOT's maintenance areas and, with funding provided by the Minnesota Local Road Research Board, to county and city maintenance facilities. These visits are intended to bring new technology to the field, gather similar information from the field, and exchange this information between the maintenance units as well as between the various units of government. This program has helped Mn/DOT fulfill its goal of facilitating the transfer of FHWA, Transportation Research Board (TRB) and other national and international transportation technology to local government agencies in Minnesota. To link the program to something that its customers could identify and easier visualize, Mn/DOT provided a refurbished van with the Circuit Rider partnership logo painted on it, as illustrated in Figure 1. This van, along with a trailer donated by the FHWA, is used for transporting the program-related equipment and displays from site to site.

The specific program site activity is highlighted by a periodically changed photo display of about thirty 11"x

14" photos that are changed as new highway maintenance innovations are discovered. The program also includes an interactive compact disc (CDI) training system provided by the Center for Transportation Studies, currently featuring sessions on winter maintenance and work zone safety. It also includes extensive literature provided by the FHWA, Mn/DOT and others as well as demonstrations of selected work zone safety devices and other equipment innovations. A trained facilitator with a highway maintenance background discusses new innovations presented in the photo display and/or presents a structured training workshop on a given topic such as snow & ice control, use of prewetting, pavement rehabilitation, etc. The facilitator will also explain and distribute displayed literature, encourage submission of innovative ideas from the participants and document innovations observed at the visited site. An example of a Circuit Rider workshop presentation is shown in Figure 2.

During 1995, the program's first year of operation, the Circuit Rider visited 46 locations including visits to Mn/DOT, county and municipal facilities with additional visits to Canada and eastern US states. The greatest accomplishments were that training was brought to the maintenance personnel at their place of work for reduced cost and increased accessibility, and that many local innovations were discovered, documented, and shared with other governmental agencies. In addition, barriers between all levels of government were lowered, thereby increasing information exchange and encouraging financially beneficial partnerships, such as sharing equipment and facilities.

During 1996, 50 to 60 scheduled workshops are planned to local government facilities within Minnesota. This training will be provided by Mn/DOT Circuit Rider facilitators, coordinated and advertised by the CTS, and funded by the Minnesota LRRB. In addition to these site visits, similar workshops will be scheduled to Mn/DOT



FIGURE 1 Circuit rider van.



FIGURE 2 An example of a circuit rider workshop presentation.

facilities. By coordinating the Circuit Rider Program through a formal partnership, the workshops can be scheduled to reduce duplication and to increase efficiency benefiting all partners since all neighboring Mn/DOT and local government agencies are invited to attend any given workshop despite the location of the facility.

INTERNATIONAL ACTIVITIES

The Maintenance Operations Research Unit actively supports Mn/DOT's leading role in maintenance research. Part of this activity is Mn/DOT's outreach to several countries to obtain benchmark on their winter maintenance and other technologies. Continuous cooperative research coordination is being maintained with several Canadian provinces, Sweden, Norway, Finland and Japan. Still other contacts have been made with the Republic of Korea, Australia and several European countries. Some of the current active joint research projects include a continuous friction measurement evaluation project with the Norwegian Public Roads Administration, testing of Swedish cutting edges, as well as a salt usage comparison study and a maintenance worker exchange with the Finnish National Road Administration.

RESEARCH PROJECT FUNDING

The annual base budget committed to maintenance operations research is \$750,000. Additional funding is

periodically received for specific research projects from other research bodies such as the FHWA and Minnesota LRRB. A breakdown of Maintenance Operations Research Program funding for Fiscal Year 1995 (July 1, 1994 to June 30, 1995) by program category is shown in Figure 3.

The program involves large research projects which may have funding approved for over two or more fiscal years, as well as spontaneous "skunk works" type projects costing less than \$12,000. Research proposals with funding requests of more than \$12,000 are considered for approval by the Area Maintenance Engineers' New Technology Research and Equipment Committee (NTREC), whereas the MORE has authority to approve projects costing up to \$12,000. The NTREC Committee typically meets quarterly to consider the larger project proposals submitted to the MORE.

To help manage the Maintenance Operations Research Program's annual budget, funding approvals and actual payments, as well as other data related to individual research projects, a project tracking system has been designed and is in place. The project tracking system provides easy access to Mn/DOT users who are able to view summary research information on on-going and historical projects, as well as to print out completed field test reports. The application is programmed on Paradox 5.0 for Windows, and is part of a statewide effort of linking various research databases together in order for Minnesota to be able to provide a better and more up-to-date service to transportation research professionals.

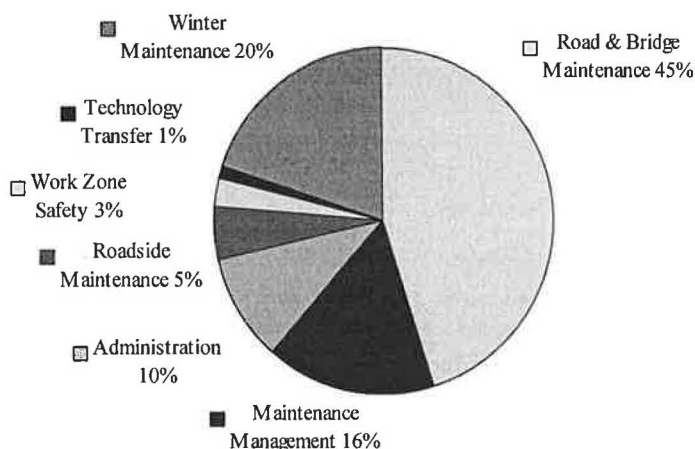


FIGURE 3 Maintenance Operations Research Program: Expenditures in Fiscal Year, 1995 [3].

CURRENT RESEARCH PROJECTS

Individual Maintenance Operations Research Program project report summaries including photos, sketches and text to describe selected projects, and their intended or expected outcomes, with the contact persons' phone numbers, can be found in Annual Statewide Maintenance Research Reports for years 1993, 1994 and 1995 [1, 2, 3]. The latest Annual Report 1995 [3] also contains a listing of smaller research projects underway in 1995, a listing of new projects approved for funding but not yet started, and a complete listing of maintenance research projects prior to 1995.

Roadside Maintenance

As unwanted weeds are treated it is necessary to use different herbicides to obtain maximum control of unwanted vegetation. To accomplish this, four automated sprayer prototypes were designed and evaluated. Other related research projects included weedmats, a remote slope mower, and biological control of Canada Thistle, etc.

Winter Maintenance

Mn/DOT's winter maintenance research focuses on maintaining roadway friction and a high level of safety while reducing salt and sand use, minimizing impacts on

the roadside environment and minimizing corrosion [5]. Currently research is being conducted on integrated tailgates (as pictured in Figure 4.), improved snow plows and cutting edges, maintenance concept vehicle, vehicle (snow plow) conspicuity studies, snow fence evaluation, and continuous friction measurement, etc. Special effort has been put toward research relating to deicing and anti-icing methods, prewetting using salt brine and other chemicals, salt brine mixing systems, zero-velocity spreader concept, automated bridge de-icing systems, etc. Out of a total of over 800 trucks involved in snow removal, approximately 345 of them were operational with prewetting units by the end of the winter season 1995-1996.

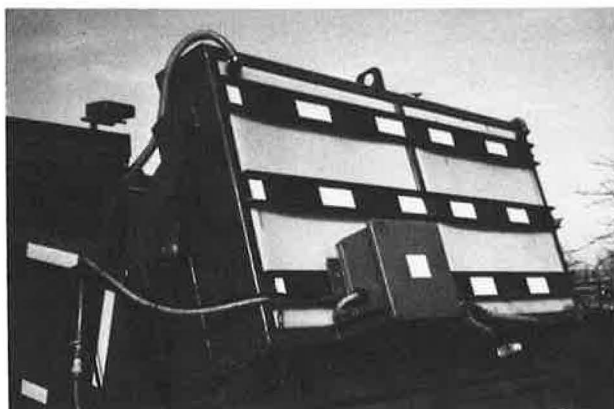


FIGURE 4 Reed integrated tailgate.

Road & Bridge Maintenance

Providing a smooth pavement for safe and efficient travel is one of the most important aspects of Mn/DOT's responsibilities. A Mn/DOT Statewide Smooth Pavement Task Force has been very active in addressing the issue of providing smoother, longer-lasting pavement surfaces. While the original focus of the Task Force was to eliminate potholes, current research projects include issues relating to slurry sealing, rough patching, crack sealing, micro surfacing, etc. Experiments are being conducted in the winter and the summer months, trying to find the most efficient and economical patching and crack sealing methods in both cold and hot climates.

Maintenance Management

Mn/DOT is in the process of developing its maintenance business planning products and services, as well as various aspects of a uniform statewide operations management system, including timesheet management system, and a pavement marking management system. Other on-going research projects relate to road weather information systems, thermal mapping, pavement condition and weather reporting, interactive travel information system, automated call-out system, bar-coding, paperless field data collection, automated route planning, etc.

CONCLUSION

Originally it was expected that the Maintenance Operations Research Program would be in place for a few

years during which the individual Mn/DOT Districts would form their own processes for conducting maintenance operations research independently. The program has to some extent been able to help in achieving this goal, yet a need for a central body for administering statewide, national and international maintenance research activities has been realized. The Maintenance Operations Research Program will therefore continue to promote the importance of researching new innovative methods for preventive maintenance, and to ensure active two-way technology transfer through the Minnesota Circuit Rider Program.

REFERENCES

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