

**U.S. Department of Transportation
Research and Innovative Technology Administration
University Transportation Center Grant Agreement**

**Grant No. DTRT12-G-UTC08
Mountain-Plains Consortium, North Dakota State University
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**North Dakota State University
Upper Great Plains Transportation Institute
NDSU Dept. 2880, P.O. Box 6050, Fargo, ND 58108-6050**

Grant period: January 1, 2012 – January 31, 2016

**Reporting Period End Date: December 31, 2012
Semi-Annual PPPR#2**

Denver D. Tolliver



**Director, Mountain-Plains Consortium
North Dakota State University**

1. Accomplishments: What was done? What was learned?

a. What are the major goals of the program?

The overall objectives are to: (1) conduct basic and applied research, the products of which are judged by peers or other experts in the field of transportation to advance the body of knowledge in transportation; (2) offer an education program in transportation that includes multidisciplinary course work and participation in research; (3) conduct workforce development activities and programs to expand the workforce of transportation professionals; and (4) provide an ongoing program of technology transfer to make transportation research results available to potential users in a form that can be readily used. Other program goals are to select projects and activities using peer review principles and procedures and client input that: (1) address the Secretary's five strategic goals, and (2) leverage UTC funds with matching funds from state and local governments and private industry. The chief operational goals are to make important contributions to research and technology transfer in key areas related to the Secretary's goals of State of Good Repair, Safety, and Economic Competitiveness, while addressing critical issues of the region and stakeholder groups.

b. What was accomplished under these goals?

i. Project Selection

More than 40 research projects have been selected and initiated through a peer review process that reflects substantial input and matching resources from state departments of transportation and MPOs in the region. Collectively, this set of projects addresses all five of the Secretary's strategic goals and several of USDOT's requested emphasis areas under State of Good Repair—e.g., (1) bridge condition monitoring, (2) locating critical infrastructure defects, (3) identifying tools to prevent and detect corrosion in transportation infrastructure, (4) analytical tools for infrastructure performance management, and (5) methods and criteria to measure performance of new materials and methods. Other research projects are related to the Secretary's strategic goals of Safety, Economic Competitiveness, Livable Communities, and Environmental Sustainability.

The projects selected under the grant are listed in Tables 1-5, under the primary strategic goal addressed by the project. Nevertheless, note that most of the projects address several goals simultaneously. In particular, many projects that address State of Good Repair have Safety and Economic Competitiveness benefits.

Table 1: MPC Research Projects Most Directly Correlated with State of Good Repair

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1. Geotechnical Limit to Scour at Spill-Through Abutments (Year 2)
 2. Seismic Performance of Self-Consolidating Concrete Bridge Columns and Connections
 3. Comprehensive Analysis of Long-Term Bridge Performance
 4. Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks – Instrumentation Development and Validation
 5. Quantifying the Performance of Constructed Bridges in Cold Regions: Development, Assessment, and Repair

Table 1: MPC Research Projects Most Directly Correlated with State of Good Repair

6. Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete Bridge Decks in Cold Regions
 7. Integrated Real-Time Health Monitoring and Impact/Collision Detection System for Bridges in Cold Remote Regions
 8. Improved Understanding of Pavement Impacts and Cost-Effective Designs Based on Mechanistic Empirical Methods
 9. Seismic Behavior of Steel Bridges with Fatigue-Prone Details
 10. Seismic Performance of Highway Embankments
 11. Assessing Existing Transportation Sustainability Rating Systems
 12. MEMS Sensors for Transportation Structures
 13. Plastic-Aluminum Composites in Transportation Infrastructure
 14. Design and Construction Monitoring of Surcharged Embankment
 15. Implementation of Low-Temperature Test for Asphalt Mixtures to Improve Longevity of Road Surfaces
 16. Evaluation of Spliced Sleeve Connections for Precast Reinforced Concrete Bridge Piers
 17. Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
 18. Quantifying Uncertainty in Non-Destructive Bridge Inspection Methods for use in Performance Based Inspection
 19. Accelerated Bridge Construction in South Dakota: Pilot Study for Implementation Strategy
 20. Extent, Severity, and Location of Chip Seal Loss on the South Dakota State Road Network
 21. Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
 22. Evaluation of Ice Loads on Bridge Piers in South Dakota (Years 2 & 3)
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Table 2: MPC Research Projects Most Directly Correlated with Safety

1. Developing Statistical Models for Crash Severity Comparing Statewide, County and Indian Reservation Roads
 2. Effectiveness of Advisory Letter in Preventing At-Risk Teen Driver Crashes: Pilot Project
 3. ND Motor Crash Analysis and Rider Assessment for Improved Conspicuity
 4. Anticipatory Guidance for Older Drivers
 5. Decision Support for Strategic Truck Safety and Weight Enforcement Planning
 6. Investigation of Interactions Between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
 7. Modeling, Analysis and Evaluation of Urban Arterial Work Zone
 8. Modeling and Evaluation of Traffic Signal Preemption near Railroad Crossings in Small Urban Areas
 9. Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements
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Table 3: MPC Research Projects Most Directly Correlated with Economic Competitiveness

1. Small Railroad Capital Investment Needs and Financial Options
2. Educational and Workforce Development: STEM Outreach at Colorado State University
3. A Two-Stage Approach for Estimating a Statewide Truck Trip Table
4. Understanding Public Perceptions of Different Revenue Generation Systems for Highway Construction and Maintenance
5. Selection of Discount Rates for Infrastructure Investment
6. Comprehensive GIS-Based Rural Regional Transportation Planning Models
7. Use of Travel Time, Travel Time Reliability, and Winter Condition Index Information for Improved Operation of Rural Interstates
8. Review of Road User Costs (RUC) and Methods

Table 4: MPC Research Projects Most Directly Correlated with Livable Communities

1. Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, CO
2. Traffic Modeling of Transit Oriented Development

Table 5: MPC Research Projects Most Directly Correlated with Environmental Sustainability

Do Changing Prices Portend a Shift in Fuel Consumption, Diminished Greenhouse Gas Emissions, and Lower Fuel Tax Revenue?

ii. Programmatic Milestones

The milestones achieved in establishing the program and meeting the required dates and guidelines were detailed in Program Progress Performance Report #1. These accomplishments are summarized in Table 6, along with additional milestones that are now underway or complete. Details associated with these added milestones are discussed in this report (Program Progress Performance Report # 2).

Table 6: Review of Program Milestones

Milestone Event	Start Date	End Date
Development of proposal guidelines (Table 7 of PPPR # 1)	1/1/2012	1/12/2012
Call for proposals	1/12/2012	2/15/2012
Participation in UTC/CUTC meeting at TRB	1/22/2012	1/22/2012
Execution of grant agreement	2/15/2012	12/31/2013
Peer review of proposals	2/15/2012	4/15/2012
Publication of center directory	2/15/2012	5/13/2012
Center webpage fully operational	2/15/2012	5/13/2012
Selection of theme	2/15/2012	2/15/2012
Selection of projects	3/15/2012	6/15/2012
Posting of projects on webpage	4/15/2012	7/15/2012
Submittal of implementation plan	5/21/2012	5/21/2012

Table 6: Review of Program Milestones

Milestone Event	Start Date	End Date
Site visit by UTC program administrators	5/30/2012	5/30/2012
Participation in UTC/CUTC summer meeting	6/20/2012	6/23/2012
Delivery of workforce development programs and activities	2/15/2012	12/31/2013
Delivery of multimodal multidisciplinary educational program	6/01/2102	12/31/2012
Conduct of multimodal multidisciplinary research program	3/15/2012	12/31/2012

iii. Educational Accomplishments

Because the grant was executed in February 2012, educational accomplishments will be reported beginning with the summer semester of 2012. The transportation and transportation-related courses offered during these two semesters are listed in Table 7, organized by major subject area. In some cases, courses with the same titles were offered at more than one MPC university. In these cases, the number of courses offered is shown in parenthesis.

Table 7: Transportation and Transportation-Related Courses Offered Thus Far

Major Subject Area	Course Title
Engineering & Design	Introduction to Transportation Engineering (undergraduate, 2)
	Transportation Engineering: Fundamentals (2)
	Highway Engineering (undergraduate)
	Highway and Traffic Engineering
	Advanced Highway Engineering and Design
	Advanced Street & Highway Design
	Pavement Design
	Bridge Engineering
	Infrastructure Evaluation and Renewal
	Airport Planning & Design (2)
	Geometric Highway Design (2)
	Highway Capacity Analysis (2)
Freight & Logistics	Introduction to Transportation and Logistics (undergraduate)
	Freight Transportation Systems
	Intermodal Transportation Systems
	Logistics Systems
	Logistics Decision Analysis
	Global Trade
	International Logistics Management
Case Studies in Logistics	
Planning & Environment	Transportation Planning Methods
	Transportation Law and Regulation
	Urban and Regional Transportation Planning
	Community Development Process

Table 7: Transportation and Transportation-Related Courses Offered Thus Far

Major Subject Area	Course Title
	Urban Form Theory
	Urban Design Studio*
	Introduction to Sustainable Urban Infrastructure
	Transportation Planning & Environmental Compliance
	Air Quality Management
	Geographic Information Systems (2)
Public Transportation	Public Transportation (3)
	Passenger Transportation Systems
Traffic & Operations	Transportation Operations
	Traffic Operations and Control (2)
	Traffic Simulation
	Traffic Engineering
	Traffic Signal Design and Technology
	Advanced Traffic Control
Transportation Safety	Transportation Safety
	Highway Safety
	Traffic and Safety Data Analysis
Transportation Systems	Transportation Systems I
	Transportation Systems Analysis
	Transportation System Modeling
	Transportation Network Analysis (2)
	Urban Transportation Systems Analysis
	Transportation Systems Security

* The focus of the fall 2012 Urban Design Studio was on Interstate 70 in Denver, CO.

Altogether, 57 transportation and transportation-related courses have been offered since the start of the grant. In addition to the courses listed in Table 7, foundational courses in engineering materials, mechanics, structural analysis, and geotechnical engineering have been offered at most of the MPC universities.

iv. Workforce Development Accomplishments

Training: A list of training events provided for transportation professionals since the start of the grant is presented below.

1. ATSSA Flagger Certification
2. ATSSA Traffic Control Supervisor (TCS)
3. ATSSA Traffic Control Technician (TCT)
4. Basic Concepts for Pavement Preservation
5. Basic Sign Installation and Maintenance
6. Basics of a Good Road
7. Certification Training for Aggregate Materials

8. Certification Training for Concrete Field Testing
9. Certification Workshop for Asphalts Concrete: Designing & Building Successful Projects (2)
10. Cold-In-Place Recycling (CIR), Hot-in-Place (HIR) and Full Depth Recycling (FDR)
11. Construction Inspection (2)
12. Construction Inspection Work Plan Development
13. Context Sensitive Solutions and Related Tools and Options
14. Erosion & Sediment Control on Construction Projects
15. Geosynthetic Reinforced Subgrades and Bases
16. Gravel Road Maintenance
17. Heavy Equipment Safety Operations
18. Highway Pipe Installation – Construction Installation and Inspection Training
19. Highway Safety Manual Practitioner’s Guide for Rural Two-Lane Roads
20. HiMA, Highly Polymer Modified Asphalt: Doing More with Less
21. Local Project Administration (LPA) Certification
22. Maintenance Decision Support Systems and Weather Forecasting for Beginners
23. Maintenance Decision Support Systems and Weather Forecasting for Beginners
24. Managing Organizational Communication
25. Micro-Surfacing/Slurry Seals
26. Noxious Weeds
27. OSHA Work Zone Safety
28. Technical Resources for Crash Reduction Improvements
29. The Changing Face of America: Diversity and Its Implications for Managers and Supervisors
30. Tractor Operator Safety: Roadside Mower Training
31. Trench Safety and Utility Cuts
32. Warm Mix Asphalt – State of the Art
33. Winter Road Maintenance
34. Work Zone and Flagging, including ATSSA Flagger Certification
35. Work Zone Safety and Mobility Traffic Control Training (For Supervisors)
36. Work Zone Safety and Mobility Traffic Control Training (for Workers and Supervisors)

Conferences, workshops, and publications are summarized under “products.”

c. How have the results been disseminated?

The results are being disseminated in a variety of ways, including: (1) workshops and conferences, (2) videoconferences, (3) online modules, (4) presentations at conferences, (5) publications, (6) webpage postings and displays, and (7) Internet-based dissemination media, including broadcast emails and webinars.

Because the effective starting dates of most research projects were from mid-March to mid-April, most of the tangible results at this stage of implementation consist of workforce development and outreach activities. These accomplishments are summarized under the Products section of this report.

d. What do you plan to do during the next reporting period to accomplish the goals/objectives?

No changes are foreseen to the accepted plan and implementation schedule.

2. Products: What has the program produced?

a. Publications, conference papers, presentations

i. Key Conferences and Workshops

- University of Utah: The New Highway Safety Manual: Urban Applications, Workshop 1 of the 4th Urban Street Symposium, Chicago, IL.
- University of Utah: Introduction to Large-scale Dynamic Traffic Assignment and Its Application in Safety Prediction and Road Pricing, Single-day workshop at North Carolina State University, Raleigh, NC.
- University of Utah: Effective Integration of Analysis and Modeling Simulation Tools, Webinar at FHWA Research Center, Washington DC.
- University of Utah: Characterizing Dispersion and Orientation of Synthetic Fibers in Concrete Pavements, 3rd Workshop on Innovations and Modeling for Sustainable and Resilient Concrete Pavements, Lac Delage, Quebec.
- University of Colorado Denver with the Denver Regional Council of Governments (DRCOG): Sustainable Communities Initiative: Outcomes Assessment and Knowledge Sharing (OAKS)
- University of Colorado Denver with the Buechner Institute for Governance: Health and the Built Environment: Creating Healthy Cities
- University of Colorado Denver with Colorado DOT Traffic Data Committee: Update on Estimating Annual Average Daily Bicycle and Pedestrian Traffic
- University of Denver with Montana Transportation Institute: Energy & Intermodal Transportation in Urban Settings Transportation Policy Forum “Implications of MAP-21”
- University of Denver with the Eno Foundation: Transportation Policy Forum “Infrastructure Financing Options”

ii. Key Presentations

- Bordelon, A., and J. Roesler. “Distribution of Fiber-Reinforcement in Thin Concrete Overlays.” 10th International Conference on Concrete Pavements, International Society for Concrete Pavements, Quebec City, July 11, 2012.
- Bordelon, A. “Using Fiber-Reinforcement in Concrete for Thin Overlays, Parking Lots, and Pavements.” American Public Works Association Utah Chapter Fall Conference and Stormwater Expo, Sandy, UT, October 2, 2012.
- Bordelon, A. “Thin Concrete Overlay Pavements and Use of Fiber-Reinforcement.” Utah DOT Annual Conference, Sandy, UT, October 30, 2012.
- Le, T.Q., C.K. Lund, and R.J. Porter. “Safety Effects of Cross Section Design on Urban and Suburban Roads.” 4th Urban Street Symposium, Chicago, IL, June 26, 2012.

- Przybyla, J., J. Taylor, J. Jupe, and X. Zhou. “Simplified, Data-Driven, Errorable Car-Following Model to Predict the Safety Effects of Distracted Driving.” IEEE Intelligent Transportation Systems Society Conference, Anchorage, Alaska. (Best Conference Paper Award) September 16, 2012.
- Wehbe, N., S. Pei, and B. Ahrenstorff. “Calibration of AASHTO’s Ice Loads Equations for Bridge Piers in South Dakota.”. Special Public Session: Load Rating and Assessment of Bridges, the 18th IABSE Congress. Seoul, Korea. September 21, 2012.
- Taylor, J., and X. Zhou. “Computational Methods for Investigating Intradriver Heterogeneity using Vehicle Trajectory Data.” Institute for Operations Research and the Management Sciences (INFORMS) Annual Conference, Phoenix, Oct 14, 2012.
- Tolliver, D. “Transportation Infrastructure to Support Domestic Energy Production.” REMI Great Lakes Transportation Conference, Ann Arbor MI, June 26, 2012.
- Tolliver, D. “Infrastructure and Safety Impacts of Oil Development on Tribal Roads.” Second National Tribal Transportation Safety Summit, Mystic Lake Casino, MN, August 29, 2012.
- Tolliver, D. “Impacts of Oil Development on Road Infrastructure Needs.” Northern Plains Tribal Transportation Planning Conference, Bismarck, ND, September 6, 2012.
- Tolliver, D. “MAP-21: Transportation Planning Context.” Intertribal Transportation Planning Conference, Las Vegas, NV, December 13, 2012.
- Zhou, X. and H. Niu. “Optimizing Urban Rail Timetable under Time-dependent Demand and Oversaturated Conditions.” Presented at INFOMRS Annual Conference, Phoenix, Oct 16, 2012.

b. Books or other non-periodical, one-time publications

Nothing to report at this time.

c. Website(s) or other internet site(s)

The MPC website is fully operational at:

<http://www.mountain-plains.org/>

d. Technologies or Techniques

Nothing to report at this time.

e. Inventions, patent applications, and/or licenses?

Nothing to report at this time.

f. Other

Nothing to report at this time.

3. Participants and Other Collaborating Organizations: Who has been involved?

a. What individuals have worked on the program?

The principal investigators, faculty, and administrators participating in MPC projects at **Utah State University** are:

1. Kevin Heaslip, University Program Coordinator and PI (Transportation Engineering)
2. Paul Barr, PI
3. Ryan Bosworth, Co-PI (applied economics)
4. Michael Thomas, Investigator (economics)
5. Rebecca Winstead, TIMELab Administrator

Students participating in MPC research projects at **Utah State University** are:

1. Ali Soltani Sobh, Ph.D. student (transportation engineering)
2. Donghyung Yook, Ph.D. Student (transportation engineering)
3. Mr. Sarawut Jansuwan, a Ph.D. student from Utah State University, who is investigating the FAF³ commodity flow database.
4. Ms. Areekamol Tor. Chaisuwan, a visiting Ph.D. student from Burapha University, Thailand, who is involved in data collection efforts.
5. Conner Huffaker, graduate student

Others participating in MPC projects at **Utah State University** include Hugh Boyle (a consultant).

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Wyoming** are:

1. Khaled Ksaibati, University Program Coordinator and PI
2. Robert Ettema, PI
3. John Turner, PI
4. Rhonda Young, PI
5. Richard J. Schmidt
6. Robert G. Erikson
7. Hilmar L. Heininger
8. Debbie Shinstine

Students participating in MPC research projects at the **University of Wyoming** include Taylor J. Kasperick.

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Utah** are:

1. Steven Bartlett, Associate Professor (geotechnical);
2. Evert Lawton (Co-PI), Professor (geotechnical);
3. Chris Pantelides, Professor (structures);
4. Lawrence Reaveley (Co-PI), Professor (structures);
5. Pedro Romero, Associate Professor (materials/pavements); and
6. Xuesong Zhou, Assistant Professor (transportation)

Graduate and undergraduate students working on MPC research projects at the **University of Utah** include:

1. Zacgary Jones (masters)
2. Charan Chandika (masters)

3. Mohammad Ameli (PhD)
4. Joel Parks (masters)
5. Dylan Brown (undergraduate)
6. Ivana Tasic (PhD)
7. Milan Zlatkovic (PhD)

The principal investigators, faculty, and administrators participating in MPC projects at **South Dakota State University** are:

1. Nadim Wehbe, University Program Coordinator and PI
2. Allen Jones, PI
3. Xiao Qin, PI
4. Zhiguang Wang, PI
5. Shiling Pei, PI
6. Haifa Samra, PI

Graduate and undergraduate students working on MPC research projects at **South Dakota State University** include:

1. Brittney Ahrenstorff
2. Chase Cutler
3. Todd Pauly (starting August 2012)
4. Melissa McMullen (starting August 2012)
5. Nicole Campbell (undergraduate)

The principal investigators, faculty, and administrators participating in selected projects from **Colorado State University** are:

1. Rebecca Atadero, University Program Coordinator and PI
2. Paul Heyliger, PI
3. Suren Chen, PI
4. Hussam Mahmoud, Co-PI
5. Mehmet Ozbek, Co-PI
6. Caroline Clevenger, Co-PI

Graduate and undergraduate students working on MPC research projects at **Colorado State University** include:

1. Alex Hesse (masters)
2. Paula Miller (masters)
3. Greg Yucha (masters)

The principal investigators, faculty, and administrators participating in selected projects from **North Dakota State University** are:

1. Kimberly Vachal, University Program Coordinator and PI
2. Andrea Huseeth , PI
3. Mark Berwick , PI
4. Brenda Lantz , PI
5. Frank Yazdani , PI

6. Dr. Mijia Yang, PI
7. Doug Benson, PI
8. EunSu Lee, PI
9. Pan Lu, PI
10. Denver Tolliver, Director

Graduate and undergraduate students working on MPC projects at **North Dakota State University** include:

1. Agrawal, Ankush
2. Campbell, Eileen
3. Dang, Vu
4. DeHaan, Christopher
5. Holt, Luke
6. Itani, Maher
7. Kayabas, Poyraz
8. Kazemi, Yasaman
9. Liu, Qing
10. Mistry, Dilip
11. Park, Ju Dong
12. Shakya, Sumadhur
13. Siriward, Thushara
14. Telste, Michael
15. Zheng, Zijian

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Denver** include:

1. Patrick Sherry, University Program Coordinator and PI.

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Colorado Denver** include:

1. Wesley Marshall, University Program Coordinator and PI
2. Jimmy Kim, PI

b. What other organizations have been involved as partners?

The timing of match funding and the commitments of collaborators vary widely and are still unfolding. At this time, we have the following committed collaborators. However, others may be added. Key participants from many of these organizations will be named at a later date, when their funding and personnel availability becomes more certain.

1. South Dakota LTAP: Ken Skorseth
2. South Dakota DOT: Daris Ormesher, Aaron Breyfogle, Dustin Artz, Megan Steever
3. South Dakota Department of Public Safety (To be identified later)
4. SD Department of Public Health (To be identified later)
5. North Dakota Highway Patrol: (To be named later)
6. North Dakota Department of Transportation (To be named later)
7. Utah Department of Transportation (To be named later)
8. New York State Department of Transportation (To be named later)

9. Texas Department of Transportation (To be named later)
10. Utah Transit Authority (To be named later)
11. Hanson Structural Precast (To be named later)
12. NIST (To be named later)
13. Tegracore (To be named later)
14. Wind River Indian Reservation (To be named later)
15. Washington Department of Transportation (To be named later)
16. W.R. Grace (donated admixtures)
17. GCC of America (donated cement)
18. Headwater Resources (donated Class F fly ash)
19. LG Everest (donated aggregates)
20. Buechner Institute for Governance
21. Colorado DOT Traffic Data Committee
22. Eno Foundation

c. Have other collaborators or contacts been involved?

The list of collaborating organizations in 3(b) is complete, as of December 31, 2012.

4. Impact

At this time, the impact of the projects and overall program cannot be judged. Therefore, we have nothing to report.

5. Changes/Problems

No changes are foreseen at this time.

5a. Additional Information Regarding Products and Impacts

Nothing to report at this time.

PROGRAM OUTPUTS: Nothing to report at this time.

PROGRAM OUTCOMES: Nothing to report at this time.

PROGRAM IMPACTS: Nothing to report at this time.

6. SPECIAL REPORTING REQUIREMENTS: None