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

**Grant No. DTRT13-G-UTC38**
**DTRT13-G-UTC38, Mod 1 & 2**
**Mountain-Plains Consortium, North Dakota State University**
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**April 30, 2015**

**DUNS: 803882299 and EIN: 45-6002439**

**North Dakota State University**
**Upper Great Plains Transportation Institute**
**NDSU Dept. 2880, P.O. Box 6050, Fargo, ND 58108-6050**

**Grant period: October 1, 2013 – September 30, 2018**

**Reporting Period End Date: March 30, 2015**
**Semi-Annual PPPR#3**

**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 Competiveness, while addressing critical issues of the region and stakeholder groups.

### b. What was accomplished under these goals?

#### i. Project Selection

Twenty three research projects were selected for the 2014-2015. Projects have been selected for the original grant, while projects are still being submitted for the Modification 1 & 2 to the original grant. Thus the peer review process is ongoing for possible selection. The projects reflect 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 Competiveness, Livable Communities, and Environmental Sustainability. MPC Projects selected under this grant include; MPC-446 through MPC-469.

**Table 1: MPC Research Projects Most Directly Correlated with Safety**

1. MPC-453: Speed Selection Behavior during Winter Road Conditions
2. MPC-454: Regional Implementation of Tribal Transportation Safety Program
3. MPC-455: Why Are Bike-Friendly Cities Safer for All Road Users?
4. MPC-457: Tribal Emergency Preparedness Planning
5. MPC-458: Application of a Multi-Agent System with the Large-Scale Agent-Based Model for Freight Demand Modeling
6. MPC-460: Technology and Workforce Development for Remote Sensing of the Transportation Infrastructure
7. MPC-461: Analytical Modeling for Progressive Failure Assessment of Curved and Skewed Highway Bridges Subjected to Seismic Hazards

8. MPC-462: Implementation of Aerial LiDAR Technology to Update Highway Feature Inventory
9. MPC-465: Development of Performance Matrices for Evaluating Innovative Intersections and Interchanges
10. MPC-467: Self-Regulation and Distraction
11. MPC-469: Improving Efficiency and Reliability of Bus Rapid Transit

**Table 2: MPC Research Projects Most Directly Correlated with State of Good Repair**

1. MPC-447: Post-Fire Ground Treatments for Protection of Critical Transportation Structures
2. MPC-448: Reducing Flood Vulnerability of Communities with Limited Road Access by Optimizing Bridge Elevation
3. MPC-449: Determining the Uncertainty in the Current Condition of Bridges for Use in Risk Based Inspection and Management
4. MPC-450: Using Building Information Modeling to Track and Assess Structural Condition
5. MPC-451: Assessing the Cost-Effectiveness of Wyoming's CMAQ Unpaved Road Dust Suppression Program
6. MPC-452: Updating the Highway Safety Manual 2010 - Part C: Regional Consideration of the Rocky Mountains and Plain Regions
7. MPC-456: Performance of Steel Girders Repaired with Advanced Composite Sheets in a Corrosive Environment: A Multi-Physics Approach Leading to Practical Design Recommendations
8. MPC-458: Application of a Multi-Agent System with the Large-Scale Agent-Based Model for Freight Demand Modeling
9. MPC-460: Technology and Workforce Development for Remote Sensing of the Transportation Infrastructure
10. MPC-461: Analytical Modeling for Progressive Failure Assessment of Curved and Skewed Highway Bridges Subjected to Seismic Hazards
11. MPC-462: Implementation of Aerial LiDAR Technology to Update Highway Feature Inventory
12. MPC-463: Rehabilitation Project Selection and Scheduling in Transportation Networks
13. MPC-464: Development of Network-Based Measures and Computational Methods for Evaluating the Redundancy of Transportation Networks
14. MPC-465: Development of Performance Matrices for Evaluating Innovative Intersections and Interchanges
15. MPC-465: Development of Performance Matrices for Evaluating Innovative Intersections and Interchanges
16. MPC-468: Performance Evaluation of Highway Surface Treatments (Phase I: Short-Term Performance)
17. MPC-469: Improving Efficiency and Reliability of Bus Rapid Transit

**Table 3: MPC Research Projects Most Directly Correlated with Economic Competitiveness**

1. MPC-451: Assessing the Cost-Effectiveness of Wyoming's CMAQ Unpaved Road Dust Suppression Program
2. MPC-456: Performance of Steel Girders Repaired with Advanced Composite Sheets in a Corrosive Environment: A Multi-Physics Approach Leading to Practical Design Recommendations
3. MPC-460: Technology and Workforce Development for Remote Sensing of the Transportation Infrastructure
4. MPC-463: Rehabilitation Project Selection and Scheduling in Transportation Networks
5. MPC-464: Development of Network-Based Measures and Computational Methods for Evaluating the Redundancy of Transportation Networks

6. MPC-465: Development of Performance Matrices for Evaluating Innovative Intersections and Interchanges
7. MPC-466: First and Last Mile Strategies for Transit Systems
8. MPC-468: Performance Evaluation of Highway Surface Treatments (Phase I: Short-Term Performance)
9. MPC-469: Improving Efficiency and Reliability of Bus Rapid Transit

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

1. MPC-454: Regional Implementation of Tribal Transportation Safety Program
2. MPC-455: Why Are Bike-Friendly Cities Safer for All Road Users?
3. MPC-457: Tribal Emergency Preparedness Planning
4. MPC-465: Development of Performance Matrices for Evaluating Innovative Intersections and Interchanges
5. MPC-466: First and Last Mile Strategies for Transit Systems
6. MPC-469: Improving Efficiency and Reliability of Bus Rapid Transit

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

1. MPC-447: Post-Fire Ground Treatments for Protection of Critical Transportation Structures
2. MPC-458: Application of a Multi-Agent System with the Large-Scale Agent-Based Model for Freight Demand Modeling
3. MPC-460: Technology and Workforce Development for Remote Sensing of the Transportation Infrastructure
4. MPC-469: Improving Efficiency and Reliability of Bus Rapid Transit

### ii. Programmatic Milestones

In addition to the programmatic milestones described below, several milestones embedded within individual projects have been achieved. Most of the research projects call for literature reviews. The literature reviews for those projects with the earliest starts are substantially complete. Interim reports are not required after the literature review stage. At this time, all projects are on schedule to be completed as planned during the program period.

**Table 6: Program Milestones**

| Milestone Event | Description | Start Date | End Date |
|---|---|---|---|
| Development of Proposal Guidelines | Proposal guidelines were developed by the director, in consultation with other consortium members, to ensure a consistent solicitation and project selection process that facilitates peer review and links program activities to the Secretary's strategic goals. Similar but different guidelines were developed for education, workforce development, and technology transfer projects, to reflect the differences in tasks and outcomes associated with these projects. The proposal guidelines and related information have been posted on the Center's webpage. | 09/1/2013 | 09/15/2013 |
| Call for Proposals | The solicitation of proposals occurred on each university campus, using proposal guidelines developed by the director.<br>Modification 1 call for proposals.<br>Modification 2 call for proposals | 09/15/2013<br>05/19/2014<br>04/01/2015 | 11/15/2013<br>09/19/2014<br>12/30/2015 |
| Execution of Grant Agreement | The grant was received from RITA and executed by NDSU's Sponsored Programs office. All of the necessary internal accounting and financial procedures were established, including subcontract agreements with consortium universities.<br>Modification 1 execution<br>Modification 2 execution | 11/08/2013<br>05/19/2014<br>04/01/2015 | 11/08/2013<br>05/19/2014<br>04/01/2015 |
| Center Directory | A directory of key center personnel was completed and published on the center's web page. | | 12/15/2013 |
| Center Webpage | The MPC webpage was updated and is fully functional for the current grant period | | 12/15/2013 |
| UTC/CUTC Meeting | The director and administrative staff attended the UTC/CUTC meeting at TRB and received guidance from RITA regarding the forthcoming grant. | 01/11/2014<br>06/02/2014<br>01/11/2015 | 01/16/2014<br>06/05/2014<br>01/11/2015 |
| Peer Review of Proposals | All project proposals were subjected to external and internal peer review. | 01/15/2014<br>05/19/2014<br>04/01/2015 | 03/15/2014<br>12/30/2014<br>12/30/2015 |

| | | | |
|---|---|---|---|
| Primary Focus | MPC's proposal targets the following MAP-21 research and technology deployment objectives under the goal of Improving Infrastructure Integrity: A) increase the reliability of life-cycle performance predictions used in infrastructure design, construction, and management; B) improve the ability of transportation agencies to deliver projects that meet expectations for timeliness, quality, and cost; C) reduce user delay attributable to infrastructure system performance, maintenance, rehabilitation, and construction; D) improve highway condition and performance through increased use of design, materials, construction, and maintenance innovations; and E) study vulnerabilities of the transportation system to seismic activities and extreme events and methods to reduce those vulnerabilities. | 03/15/2014 | 12/31/2015 |
| Selection of Projects | Projects were selected from the proposals received and awards were made to principal investigators, based on the peer reviews of proposals, stakeholder commitments, and the overall availability of funds. | 03/15/2014<br>09/19/2014<br>04/01/2015 | 06/15/2014<br>12/30/2014<br>12/30/2015 |
| Posting of Projects | The selected projects were posted on the MPC webpage and added to the Research in Progress database. | 05/15/2014<br>09/19/2014<br>04/01/2015 | 08/15/2014<br>12/30/2014<br>12/30/2015 |
| Site Visit | A site visit to all MPC Universities. | | Annually |

### iii. Educational Accomplishments

The transportation and transportation-related courses offered during Fall 2014 & Spring 2015 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 This Period**

| Major Subject Area | Course Title |
|---|---|
| **Engineering & Design** | CE 3500 Highway Engineering |
| | CE 4510 Pavement Design |
| | CE 5510 Pavement Design |
| | CE 5590 Pavement Materials |
| | CEE 3080 Reinforced Concrete Design |
| | CEE 3210 Introduction to Transportation Engineering |

**Table 7: Transportation and Transportation-Related Courses Offered This Period**

| Major Subject Area | Course Title |
|---|---|
| **Engineering & Design** | CEE 5070 Steel Design |
| | CEE 5230 Geometric Highway Design |
| | CEE 6130 Structural Dynamics and Seismic Design |
| | CEE 6320 Deep Foundations |
| | CEE 6930 Prestress Concrete Analysis and Design |
| | CIVE 355 Introduction to Geotechnical Engineering |
| | CIVE 367 Structural Analysis |
| | CIVE 467 Design of Reinforced Concrete Structures |
| | CIVE 553 Slope Stability and Retaining Structures |
| | CIVE 561 Advanced Steel Behavior and Design |
| | CIVE 565 Finite Element Method |
| | CIVE 567 Advanced Concrete Design |
| | CIVE 577 GIS in Civil and Environmental Engineering |
| | CIVE 578 Infrastructure and Utility Management |
| | CIVE 581A Bridge Engineering and Hazards |
| | CvEEN 2130 Statistics and Economics Undergraduate |
| | CvEEN 5420 Open Channel Flow Undergraduate |
| | CvEEN 5510 Highway Design Undergraduate |
| | CvEEN 5570 Pavement Design Undergraduate |
| | CvEEN 5920 Sustainable Materials Undergraduate |
| | CvEEN 7235 Bridge Design |
| | CvEEN 7560 Advanced Construction Materials |
| | CVEN 3602 Transportation Engineering |
| | CVEN 4602 Highway Engineering |
| | CVEN 5602 Advanced Street and Highway Design |
| | CVEN 5682 Pavement Design |
| | TL 755 Context Sensitive Solutions |
| **Freight & Logistics** | TL 711 Logistics Systems |
| | TL 725 Technology Advances and Logistics |
| | TL 721 International Logistics Management |
| | TL 752 Transportation Planning and Environmental Compliance |
| **Planning & Environment** | CEE 5240 Urban and Regional Transportation Planning |
| | CvEEN 5560 Transportation Planning Undergraduate |
| | CVEN 5460 Introduction to Sustainable Urban Infrastructure |
| | CVEN 5612 Traffic Impact Assessment |
| | TL 715 Enterprise Resource Planning |
| | TL 752 Transportation Planning and Environmental Comp |
| | URPL 5000 Planning History and Theory |

**Table 7: Transportation and Transportation-Related Courses Offered This Period**

| Major Subject Area | Course Title |
|---|---|
| **Planning & Environment** | URPL 5010 Planning Methods |
| | URPL 5040 Urban Sustainability |
| | URPL 5050 Urban Development |
| | URPL 6300 Planning Healthy Communities |
| | URPL 6350 Form and Formation of Cities |
| | URPL 6370 Sprawl and Growth Management |
| | URPL 6399 Introduction to Sustainable Urban Infrastructure |
| | URPL 6400 Community Development |
| | URPL 6550 Transportation Planning and Policy |
| | URPL 6645 Disaster/Climate Change Planning |
| | URPL 6650 Planning in the Developing World |
| **Public Transportation** | CVEN 5800 Transit Design |
| | CvEEN 7590 Public Transportation |
| | TL 786 Public Transportation |
| **Traffic & Operations** | CEE 5220 Traffic Engineering |
| | CVEN 5621 Highway Capacity Analysis |
| | CVEN 5622 Traffic Operations and Control |
| | CvEEN 3520 Transportation Engineering |
| **Transportation Safety** | PSY 3120 Cognitive Psychology |
| | CEE 6250 Transportation Data/Safety Analysis |
| **Transportation Systems** | CEE 6210 Transportation Systems Analysis |
| | CEE 6290 Transportation Network Analysis |
| | CvEEN 7920 Statistical and Econometric Analysis |
| | CVEN 5633 Case Studies in Sustainable Transportation |
| | CIVE 303 Infrastructure and Transportation Systems |
| | TL 751 Transportation System Security |
| | TL 753 Transportation Systems Modeling |
| | TL 754 Urban Transportation Systems Analysis |
| | TL 756 Transportation Systems Lab |
| | TL 782 Transportation Systems I |
| | TL 783 Transportation Systems II |
| | URPL 6555 Transportation and Land Use |

Altogether, 76 transportation and transportation-related courses have been offered this reporting period, for a total of 210 total transportation courses offered this grant period. In addition to the courses listed in Table 7, foundational courses in engineering materials, mechanics, structural analysis, and geotechnical engineering were offered at most MPC universities.

### iv. Workforce Development Accomplishments

**Training:** A list of training events provided for transportation professionals during this reporting period is presented below.

1. 2015 Oil & Gas Producing Counties Roundtable - On-Site – Killdeer
2. 3-State Roundtable- Environmental Process
3. 7th Annual American Concrete Institute Chapter Concrete Spring Symposium
4. ADA
5. ATSSA Flagger Certification
6. ATSSA Traffic Control Technician (TCT) (TCS)
7. Asphalt Crack Sealing
8. Asphalt Maintenance I and II
9. Asphalt Paving Maintenance I
10. Basics of a Good Road
11. Break Through with Barriers- Core Skills for Interpersonal Communication
12. Communication Skills for Supervisors
13. Construction Project Management/Contract Administration
14. Erosion Control Options
15. Global Positioning Systems
16. Guardrail- Installation and Inspection
17. Heavy Equipment Operations
18. Heavy Equipment Safety Operations
19. Highway Pipe Installation- Construction and Inspection
20. Hiring Smart: Staffing for Optimum Performance
21. Landslides- Slope Stability and Hydrology
22. Leadership Skills: Creating Success for your Team
23. Leading a Successful Change Effort
24. Legal Aspects of Traffic Control on Construction Projects (Tort Liability)
25. Local Roadways Snow & Ice Control On Site Dickinson, Bismarck, Valley City, Stanley and Minot
26. Managing Organizational Communication
27. NEPA
28. Pavement Markings for Maintenance Employees
29. Pipe Repair Options
30. Preventing Run overs and Back overs
31. OSHA 10- Hour
32. Registered Storm water Inspector
33. Retro reflectivity for Signs
34. Road and Intersection Safety Fundamentals
35. Roadway Material
36. Seal Coat Workshop
37. State of the Guardrail Industry
38. Street Lighting
39. Transition to Supervision: Introduction to the Basics
40. Truck Weight Education & Outreach Bowman On Site
41. Truck Weight Education Workshop - On site - Cooperstown
42. Truck Weight Education & Outreach Dickinson On Site

43. Truck Weight Education Workshop - On Site - Jamestown
44. Truck Weight Education & Outreach Killdeer On Site
45. Truck Weight Education & Outreach Mandan On Site
46. Truck Weight Education & Outreach Minot On Site
47. Truck Weight Education & Outreach Mott On Site
48. Truck Weight Education Workshop - On site – Rugby
49. Truck Weight Education & Outreach Stanley On Site
50. Truck Weight Education & Outreach Watford City On Site
51. Truck Weight Education & Outreach West Fargo On Site
52. Truck Weight Education & Outreach Williston On Site
53. Welding
54. Western Counties Sign Truck - Show & Tell (Roundtable Discussion) On-Site
55. Winter Road Maintenance
56. Workplace, Equipment and Jobsite Safety
57. WYDOT Aggregate Certification
58. WYDOT Asphalt Certification
59. WYDOT Concrete Certification

### v. Research Accomplishments

The following peer reviewed research reports were published during the rating period from grant DTRT13-G-UTC38.

| Project # | Title | Date | Report No. |
|---|---|---|---|
| 457 | Tribal Emergency Preparedness Planning | Feb 2015 | MPC 14-276 |

### 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.

### 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

- 2015 UDOT Research Workshop (UTRAC), Sandy, UT

- 7th Annual American Concrete Institute Intermountain Chapter Concrete Spring Symposium, Salt Lake City, UT
- American Concrete Institute Convention, Washington D.C.
- Congress for the New Urbanism Transportation Summit, New York City, NY
- ITE Utah Chapter Annual Conference, Salt Lake City, UT
- Special Workshop on Sensing Technologies for Transportation Applications, Washington D.C.
- SPIE 9435 Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, San Diego, CA
- The Transportation and Safety Congress, Casper, Wyoming
- TRB Annual Meeting 2015, Washington D.C.

### ii. Key Publications

- Bright, C., Atadero, R.A., and van de Lindt, J.W. Concept Development and Experimental Evaluation of a New GRP Reinforcement Geometry for Concrete Beams, submitted to ASCE Journal of Composites for Construction, January 2015.
- Johnson, R.I. and Atadero, R.A. Simple-Made-Continuous Steel Bridges with Steel Diaphragms. Submitted to AISC's Engineering Journal, January 2015.
- Kim, Y.J., Bumadian, I., and Park, J.-S. Galvanic current influencing deterioration of CFRP bonded to a steel substrate, Journal of Materials in Civil Engineering, ASCE, submitted
- Kim, Y.J. and Bumadian, I. Electrochemical reaction for steel beams strengthened with CFRP sheets, Journal of Composites for Construction, ASCE, submitted
- McGuire, B., Atadero, R.A., Clevenger, C., and Ozbek, M. Bridge Information Modeling for Inspection and Evaluation, Submitted to ASCE Journal of Bridge Engineering, January 2015.
- Song, Z., Yin, Y. and Lawphongpanich, S. (2015) Optimal deployment of managed lanes in general networks. International Journal of Sustainable Transportation, vol. 9(6), 431-441.
- Song, Z., Yin, Y. and Lawphongpanich, S. (2015) Optimal deployment of managed lanes in general networks. International Journal of Sustainable Transportation, vol. 9(6), 431-441.

### iii. Key Conference Papers

- Bridgelall, R., Rafert, J. B., Tolliver, D., "Hyperspectral Imaging Utility for Transportation Systems," Proc. SPIE 9435 Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, San Diego, CA, March 12, 2015.
- Marshall, W.E. and Ferenchak, N. The American Story of Inequitable Road Safety Outcomes. Congress for the New Urbanism Annual Meeting, Dallas, TX.

- Marshall, W.E. and Ferenchak, N. The American Story of Inequitable Road Safety Outcomes. Congress for the New Urbanism Annual Meeting, Dallas, TX.
- Ryu, S., A. Chen, and K. Choi. "A two-stage bicycle traffic assignment model." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.
- Ryu, S., A. Chen, and K. Choi. "Solving the stochastic multiclass traffic assignment problem with asymmetric interactions and vehicle restrictions." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.
- Shari, M. S., Chen, A., Kitthamkesorn, S., and Song, Z. (2015) Link-based stochastic loading methods for the Weibit route choice model. Transportation Research Board 94th Annual Meeting Compendium of Papers CD-ROM.
- Sharifi, M.S., D. Stuart, K. Christensen, and A. Chen. "Exploring traffic flow characteristics and walking speeds of heterogeneous pedestrian stream involving individuals with disabilities in different walking environments." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.
- Sharifi, M.S., A. Chen, S. Kitthamkesorn, and Z. Song. "Link-based stochastic loading methods for the weibit route choice model." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.

**iv. Key Presentations**

- Chamberlin, C. and Ksaibati, K. “Evaluation of the Cost Effectiveness of the CMAQ Program”. The Wyoming Association of County Engineers and Road Supervisors Meeting. Casper, Wyoming.
- Locquiao, J., and C. Liu. "Analyzing the First Mile Last Mile Problem for Transit Systems." 2014 UDOT Engineering Conference. October 29th, 2014.
- Pokharel, S., Shinstine, D., and Ksaibati, K. "Developing a Livability Program for Indian Reservations." TRB 94th Annual Meeting, Washington, DC, January 12, 2015.
- Ryu, S., A. Chen, and K. Choi. "A two-stage bicycle traffic assignment model." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.
- Ryu, S., A. Chen, and K. Choi. "Solving the stochastic multiclass traffic assignment problem with asymmetric interactions and vehicle restrictions." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.
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involving individuals with disabilities in different walking environments." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.

- Sharifi, M.S., A. Chen, S. Kitthamkesorn, and Z. Song. "Link-based stochastic loading methods for the weibit route choice model." 94th Transportation Research Board Annual Meeting, Washington D.C., USA, Jan. 11-15, 2015.
- Shinstine, D., and Ksaibati, K. "Tribal Roadway Safety Improvement Program in North and South Dakota." TRB 94th Annual Meeting, Washington, DC, January 11, 2015.
- Song, Z. "Two-stage procedure of using HOV and HOT lanes for traffic incident management." Transportation Research Board 94th Annual Meeting, Washington, D.C., January 2015.
- Song, Z. "Two-stage procedure of using HOV and HOT lanes for traffic incident management." Transportation Research Board 94th Annual Meeting, Washington, D.C., January 2015.

#### v. Other Items Produced During this Period

- A brochure promoting the availability of the project handbook was produced and will be distributed to all Native tribes by Eastern Washington University, with assistance from Tribal Technical Assistance Program regional offices.
- Bridgelall, R., Rafert, B.J., Tolliver, D., “Multi-resolution Hyperspectral Remote Sensing,” review of draft in progress
- Bridgelall, R., Rafert, B.J., Tolliver, D., “Utilities of Hyperspectral Image Analysis in Transportation,” review of draft in progress
- Dr. Marshall's graduate-level Sustainable Transportation course completed case study reports on the cities and research questions being studied in this project.
- Kim, Y.J. Assessment and rehabilitation of constructed infrastructure, Wyoming Engineering Society, Feb. 5, 2015 (Invited presenter)

### 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/

The MPC Center Director can be found at: http://www.mountain-plains.org/resources/downloads/KeyCenterDirectory.pdf?year=2014

### 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 principle investigators, faculty, and administrators participating in MPC projects:

Nine principle investigators, faculty, and administrators participating in MPC projects at **Colorado State University** are: Rebecca Atadero, CSU MPC Program Director and PI; Christopher Bareither, PI; Paul Heyliger, Co-PI; John W. van de Lindt, PI; Hussam Mahmoud, PI; Suren Chen, PI; Mehmet Ozbek, Co-PI; Caroline Clevenger, Co-PI; and Bolivar Senior, Co-PI. In addition, nine graduate students are working on MPC research projects at **Colorado State University**: Doctorate Students- Luke Chen, Yufen Zhou, Huajie Wen and Kirsten Peterson, Masters Students- Brendan McGuire, Patrick Sanders, Taylor Ray and David Turner, Undergraduate Student- Kayla Moden.

Three principle investigators, faculty, and administrators participating in MPC projects at **North Dakota State University** are: Bruce J. Rafert, PI; Raj Bridgelall, Co-PI and Jon Mielke, Faculty. In addition, one graduate students are working on MPC research projects at **North Dakota State University**: Doctoral Student- Yongshin Park. Others participating in MPC projects at **North Dakota State University** include Dick Winchell, Eastern Washington University and Graduate Research Assistant Ashley Murphy, Eastern Washington University.

Five principle investigators, faculty, and administrators participating in MPC projects at the **University of Colorado Denver** are: Wesley Marshall, MPC Director and PI; Carolyn McAndrews, Co-PI; Bruce Janson, Co-PI; Jimmy Kimm PI and Krista Norback, postdoctoral student and Co-PI. In addition, three graduate students are working on MPC research projects at the **University of Colorado Denver**: Doctorate Student- Nick Ferenchak; Masters Students- Jennifer Niemann and Ibrahim Bumadian.

Nine principle investigators, faculty, and administrators participating in MPC projects at the **University of Utah** are: Richard J. Porter, MPC Program Director; Milan Zlatkovic, PI; Cathy Liu, PI; David Sanbonmatsu, PI; David Strayer, Co-PI; Pedro Romero, PI; David Sanbonmatsu, PI; Xiaoyue Cathy Liy, PI; Joel Cooper, technical advisor and Tiffany Hortin, administration. In addition, nine graduate students are working on MPC research projects at the **University of Utah**: Doctorate Students- Jeff Taylor, Arwen Behrends, Yu Song, Ivana Tasic, Kiavash Fayyaz, Masters Students- Margaret Corrigan, Jem Locquaio, Yang Li and Daniel Sudbury.

Four principle investigators, faculty, and administrators participating in MPC projects at the **University of Wyoming** are: Khaled Ksaibati, PI; Mohamed Ahmed, PI; Rhonda Young, PI and

Bart Evans, administration. In addition, three graduate students are working on MPC research projects at the **University of Wyoming**: Masters Students- Chris Chamberlin, Rameshwor Chalise, and Sandeep Thapa. Others participating in MPC projects at the **University of Wyoming** include Dennis Trusty, Director NP TTAP and George Huntington, Wyoming $T^2$/LTAP Center.

Three principle investigators, faculty, and administrators participating in MPC projects at **Utah State University** are: Ziqi Song, PI; Kevin Heaslip, Co PI and Anthony Chen, PI. In addition, three graduate students are working on MPC research projects at **Utah State University**: Doctorate Student- Seungkyu Ryu, Masters Students- Yi He and Holly Lloyd. Others participating in MPC projects at the **Utah State University** include Xiangdong Xu, collaborator and Sarawut Jansuwan, collaborator.

### b. What other organizations have been involved as partners?

The timing of match funding and the commitments of collaborators vary widely throughout the life of the grant. During this period, we have the following committed collaborators.

1. AAA Foundation for Traffic Safety
2. Campbell County Road and Bridge Department
3. Colorado Department of Transportation
4. Colorado Department of Transportation
5. Converse County Road and Bridge Department
6. Crook County Road and Bridge Department
7. Faculty of Logistics, Burapha University, Chonburi, Thailand.
8. Fehr & Peers
9. Inberg Miller Engineers, Casper WY
10. Key Laboratory of Road and Traffic Engineering, Tongji University, Shanghai, China.
11. Lincoln County Road and Bridge Department
12. Northern Plains Tribal Technical Assistance Program
13. Northwest Tribal Technical Assistance Program
14. Sisseton Wahpeton Oyate Reservation
15. Standing Rock Sioux Tribe Indian Reservation
16. Teton County Road and Bridge Department
17. Tribal Transportation Program- Federal Highway Administration
18. Utah Department of Transportation
19. Utah Transit Authority (UTA)
20. Virginia Tech
21. Wasatch Front Regional Council (WFRC)
22. Wyoming Department of Transportation
23. Yankton Sioux Tribe

### c. Have other collaborators or contacts been involved?

The list of collaborating organizations in 3(b) is complete, as of this grant period.

## 4. Impact

Nothing to report at this time.

## 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