

# MPC-401

## Time Frame 2012-2013

---

**Project Title:**

Review of Road User Costs (RUC) and Methods

**University:**

South Dakota State University

**Principal Investigators:**

Qin, Xiao, Ph.D., PE

Assistant Professor

CEH 148, Box 2219

Department of Civil and Environmental Engineering

South Dakota State University

Brookings, SD 57007

Phone: (605)6886355

Email: [Xiao.Qin@sdstate.edu](mailto:Xiao.Qin@sdstate.edu)

**Research Needs:**

With the ever-increasing travel demand and limited capacity, traffic congestion has become part of daily life. Every year, delay from peak period traffic congestion costs \$710 a traveler. The Texas Transportation Institute (TTI) 2007 mobility report shows traffic congestion is growing worse in American cities of all sizes, creating \$78 billion in user costs annually due to lost time, and 2.9 billion gallons of fuel is wasted (1).

Although South Dakota is a primary rural state with relatively low traffic volume on highway facilities of any kind, congestion and travel delay incurred by inclement weather and construction zones can occur. In fact, more roadway repairs and building are anticipated as a result of the aging highway facilities. Road user cost will inevitably increase as delay and congestion increases on South Dakota highways. From a transportation system perspective, road user cost resulting from a highway construction project should not be omitted and therefore, many state DOTs such as New Jersey, Florida, Arizona, Ohio, Colorado, Idaho have construction-induced user cost as part of the formula when comparing work zone alternatives and estimating overall costs (2,3,4,5,6,8). Without the knowledge of the road user cost, it is not possible to obtain an optimal solution from the transportation infrastructure system standpoint. As a steward of South Dakota state highways, it is necessary for SDDOT to gain more understanding of the potential user costs associated with highway construction and the means of estimating them.

However, the existing methods of estimating road user costs are quite diverse and range from simple calculations and spreadsheets to sophisticated computer software programs that require knowledgeable operators such as the Queue and User Cost Evaluation of Work Zones (QUEWZ), QuickZone, IntelliZone software, etc. (7, 8). As a result, the methodologies can vary widely in both the complexity of input requirements and output options. For example, the

American Association of State Highway and Transportation Officials (AASHTO) “Red Book” (2003) provides a baseline model that many agencies use for RUC estimation (8). The algorithm used in this model is a function of Value of Time (VOT), Vehicle Operating Costs (VOC), and Accident Costs (AC). These variables represent lost monetary value to the user based on lengthened time of travel, operating costs of the vehicle, and damages to persons and property due to the effect of the work zone. Each agency can select their preferable methods to estimate VOT, VOC, AC and the cost rate of each; many agencies prefer to neglect the AC values as they are difficult to predict.

South Dakota has an established system of calculating road user costs set by SD1995-07, *Criteria and Guidelines for Innovative Contracting* (9). The methodology in use is contemporary but revisions to the procedures are needed to create a standardized worksheet for SDDOT that maintains up-to-date unit cost figures. Calculating road user costs effectively demands appropriate current unit costs to establish incentive/disincentive values that are comparable to surrounding areas without unacceptable margins of under or overpayment. In addition more analysis of contributing factors must be made to determine if costs such as vehicle emissions, accident costs, and vehicle type should be included in these calculations.

### **Research Objectives:**

The road user cost can be used to determine contracting mechanisms, incentives, and disincentives for construction time, and travel control strategies, project phasing, staging, and timeline that best balance construction costs with costs of delay to travelers and freight. The goal of this project is to evaluate different RUC estimation methods being utilized across the nation by state departments and agencies and recommend appropriate RUC method and tools to SDDOT with the objective of developing a standardized worksheet for use across the multiple offices. Regional agency practices regarding unit cost would also be reviewed and used to establish a procedure to keep unit costs up-to-date. Formulation of a RUC worksheet for SDDOT use with the proposed methodology and procedures to maintain current units cost data would be documented in a user manual.

### **Research Methods:**

The research will be primarily conducted through a literature review, data needs assessment, and case studies over a 9-month period. Literature review will provide a synthesis of the RUC and unit cost estimation methods applied by surrounding state DOTs and agencies, especially the states that have similar traffic volumes, including off-the-shelf or state-of-art tools to calculate RUC. With the input from the synthesis, existing data inventory at SDDOT will be assessed for developing an effective RUC or estimating extra data collection and preparation effort if necessary. Case studies will be applied for validating, comparing, and evaluating alternative RUC methods.

### **Expected Outcomes:**

Based on the literature review and data needs assessment, the research will provide a synthesis of the existing state DOT practice of RUC estimation and of methods across the U.S. and make recommendations for developing an RUC worksheet specific for SDDOT. The final technical report will include literature review, data needs assessment, case studies, findings, conclusions and recommendations.

**Relevance to Strategic Goals:**

The proposed project satisfies the FHWA strategic outcomes of 1) state of good repair; 2) safety, and 3) economic competitiveness. Updating road user cost methods used in the road project decision-making process will ensure the SDDOT proactively maintains its critical transportation infrastructure in a state of good repair without compromising traveler safety and overburdening costs. It helps to develop win-win strategies for both road users and road managers, and it helps to maximize economic returns on SD transportation investment from a system perspective.

**Educational Benefits:**

This research project will involve graduate students and undergraduate students in information search and synthesis, data collection and assessment, and case studies and comparison. It will provide first-hand research experience for students to master analytical techniques and practice their communication skills.

**Work Plan:**

The work plan is composed of the following tasks.

***Task 1: Meet with the technical panel to review the project scope and work plan. (1 month)***

The research team will meet with the technical panel to review the project scope and work plan. The meeting is expected to take place within 4 weeks of ‘notice to proceed’.

***Task 2: Perform a literature review directed towards FHWA reports and other rural surrounding states’ current methodologies for calculating road user costs. (3 months)***

A comprehensive literature review will be conducted to collect and synthesize available RUC estimation methods being utilized by other state DOTs and agencies, especially the states that have low traffic volume, including off-the-shelf or state-of-art tools to estimate RUC. Some DOTs such as New Jersey, Florida, Arizona, Ohio, Colorado, Idaho have construction-induced user cost as part of the formula when comparing work zone alternatives and estimating overall costs (2,3,4,5,6,8). The American Association of State Highway and Transportation Officials (AASHTO) “Red Book” (2003) also provides a baseline model that many agencies use for RUC estimation (8). Review emphasis will be in the areas of data requirement, estimation method, performance measures, and relevant assumptions or limitations.

***Task 3: Interview members of Project Development and Operations Support to become informed how road user costs are used at the SDDOT. (1 month)***

This task will be primarily conducted through a face to face interview with the members of Project Development and Operations Support. A questionnaire will be designed to facilitate the interview. The purpose of the interview will be to obtain detailed information on SDDOT current road user costs, procedures and gather new ideas and expectation of future improvements.

***Task 4: RUC Method Evaluation. (4 months)***

This task combines research Task 4 and 5 in the research project statement. In this task, a sensitivity analysis will be performed to determine which contributing factors should be considered in calculation of road user costs in South Dakota now and in the future. Relevant data will be collected with the assistance of SDDOT to facilitate the sensitivity analysis. Additionally, a data needs assessment will be conducted based on Task 1 and 2. The research team will work with SDDOT to identify the current data inventory and data collection activities that support the estimation of RUCs. The data needs assessment will identify the minimum data requirement and any additional data collection and preparation effort for developing an appropriate RUC method in SD.

Based on results of the sensitivity analysis and data availability, an evaluation methodology will be developed which identifies key criteria and circumstances to consider when selecting the most appropriate type of analysis tool for calculating RUC at locations throughout South Dakota. The evaluation includes, but is not limited to, technical capabilities and merits of the method to accurately estimate RUC, input (required data), output (performance measures), interface of the method, and user training and support.

***Task 5: Submit a technical memorandum and meet with the technical panel to discuss the literature review, department needs, and the proposed methodology. (2 month)***

This task combines research Task 6 and 7 in the research project statement. The research team will provide a technical memorandum that summarizes the results of Task 1 through 3. The technical memorandum will be provided two weeks prior to the meeting to the technical panel. A written response will be provided within two weeks after meeting the technical panel and address all the comments and concerns discussed at the meeting. Accordingly, the methodology will be revised based on comments from the technical panel.

***Task 6: Develop a road user cost worksheet that executes the revised methodology and that can be regularly updated by users to adjust for changes in contributing factors. (2 months)***

This task combines research Task 8 and 9. In this task, a RUC worksheet will be developed based on the revised methodology. The worksheet should include a user-friendly graphic user interface (GUI) and can be regularly updated by users to adjust for changes in contributing factors. Case studies will be used to demonstrate the worksheet application. Meanwhile, a user manual documenting the methodology and procedures for operating and updating the worksheet will be prepared.

***Task 7: Prepare a final report and executive summary of the research methodology, findings, conclusions, and recommendations. (2 months)***

The outcome of all previous tasks will be summarized to present a comprehensive review of the project. This task will prepare a final report documenting the project results, finding, data

requirements, methodologies, conclusions, and recommendations. The final report will be submitted to SDDOT technical panel for review and comments, and will then be revised to reflect these changes.

**Task 8: Make an executive presentation to the SDDOT Research Review Board at the conclusion of the project. (1 month)**

This presentation will summarize all the research activities that are accomplished in this project and any conclusions or recommendations that are resulted from the research. The project PI is expected to give an oral presentation and the members of the research team will be present at the meeting. It is anticipated that the results of the study will also be presented at regional or national conferences.

Project schedule is as follows:

Task	1	2	3	4	5	6	7	8	9
Task 1: Meet Tech. Panel									
Task 2: Literature Review									
Task 3: Interview									
Task 4: RUC Method Evaluation									
Task 5: Prepare and submit a tech memo									
Task 6: Develop a RUC worksheet									
Task 7: Prepare final report									
Task 8: Executive presentation									

**Project Cost:**

Total Project Costs: \$ 48,219

MPC Funds Requested: \$ 18,215

Matching Funds: \$ 30,004

Source of Matching Funds: SDDOT (\$25,683) and in-kind match (\$4,320)

**TRB Keywords:** Road User Cost (RUC), Value of Time (VOT), Vehicle Operating Costs (VOC), Accident Costs (AC)

**References:**

1. Texas Transportation Research Institute, Annual Urban Mobility Report, 2007
2. Road User Cost Manual (New Jersey)  
<http://www.state.nj.us/transportation/eng/documents/RUCM/pdf/RUCManual.pdf>
3. Road User Cost Calculator (Ohio)
4. Road user cost calculation (Idaho)  
[http://itd.idaho.gov/manuals/online\\_manuals/Current\\_Manuals/Design%20Manual/Road%20User%20Cost.pdf](http://itd.idaho.gov/manuals/online_manuals/Current_Manuals/Design%20Manual/Road%20User%20Cost.pdf)
5. Road User Cost Calculator — CDOT
6. “Estimating Work Zone Road User Cost for Alternative Contracting Methods in Highway Construction Projects “ [http://ascelibrary.org/coo/resource/1/jcemd4/v135/i7/p601\\_s1](http://ascelibrary.org/coo/resource/1/jcemd4/v135/i7/p601_s1)

7. “road user cost in freeway work zones” Texas study, <http://tti.tamu.edu/documents/0-5619-1.pdf>
8. “Developing a Realistic-Prototyping Road User Cost Evaluation Tool for FDOT”  
[http://www.dot.state.fl.us/research-center/Completed\\_Proj/Summary\\_CN/FDOT\\_BD015-20\\_rpt.pdf](http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_CN/FDOT_BD015-20_rpt.pdf)
9. SD1995-07, Criteria and Guidelines for Innovative Contracting