

# SOLUTIONS



## RESEARCH PROGRAMS

Winter/Spring 2019

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## PROJECT HIGHLIGHTS

### Effective Production Rate Estimation Using Construction Daily Work Report Data

[https://www.mdt.mt.gov/research/projects/const/production\\_rates.shtml](https://www.mdt.mt.gov/research/projects/const/production_rates.shtml)

Contract time for state highway projects is the maximum time allowed in the contract for completion of all work contained in the contract documents. An accurate forecast of contract time is crucial to contract administration as the predicted duration and associated cost form a basis for budgeting, planning, monitoring, and even litigation purposes. Excessive contract time is costly because it extends the construction crew's exposure to traffic, prolongs the inconvenience to the public (unnecessary increase of road user costs), hinders local businesses, increases the construction costs, and subjects motorists to less than desirable safety conditions for longer periods of time. Insufficient contract time results in higher bids, overrun of contract time, increased claims, substandard performance, and safety issues. Due to the significant importance of contract time determination, Title 23 Code of Federal Regulations (CFR) Section 635.121 requires that States should have adequate written procedures for the determination of contract time and most State Department of Transportations (DOTs), including Montana DOT (MDT), have a written document describing their procedure to determine a project's contract time. Since a transportation agency maintains numerous ongoing projects under its portfolio, accurate contract time estimation will lead to the timely completion of projects, better success rate and, efficient use of funds.



The quantity of production accomplished over a specified period is termed as production rate. Realistic production rates are the key to determining reasonable contract times which are neither excessive nor inadequate. Conventionally, state agencies publish the production rates to be used uniformly across the state. This practice helps to follow the Federal Highway Administration (FHWA) guidelines to



implement uniform production rates across the states. However, it has intrinsic constraints – the production rates vary greatly depending upon the quantity to be produced, type of project, geographical location of the project, the budget allocated for the project, seasonal limitations, weather, and contractors' capacity.

As costs of highway projects increase with time, the importance of estimating highway construction contract time has increased significantly, thereby emphasizing the need for effective production rates due to the interrelatedness between the two. By reviewing the literature, various aspects of production rate estimation were identified including factors that influence production rates, production rate adjustment factors and statistical methods, and current practices of MDT.

The MDT's construction daily work report (DWR), bid, and GIS data were cleaned and combined to form a central database to estimate realistic production rates. The major attributes in the database are the project number, project amount, work type, district, budget type, area type, labor and equipment variables, vendor ID, season, quantity, and production rate. Descriptive analysis, regression analysis, and Monte Carlo simulation were deployed to offer insights into historical projects' characteristics and production rates of 31 controlling activities of MDT.

The major findings of the descriptive analysis were statistical measures (i.e., mean, first quartile, median, and third quartile) of 31 controlling activities, which provide more practical, detailed, and updated estimates in comparison with the current published values. In addition, variations of production rates in terms of different seasons of work, districts, area types (urban/rural), and budget types were explored. Regarding project characteristics, overlay, reconstruction/new construction, and safety were the most popular work types in every district in Montana.

The study developed regression equations to estimate production rates of 27 out of 31 controlling activities. For each activity, factors that had a significant effect on production rate were included in the regression model as predictor variables. Quantity, project work type, district, number of equipment, and budget type were proved to have a significant effect on many of the controlling activities. In addition, the regression models have provided meaningful relationships between predictor variables/influencing factors and the predicted variable/production rate. Some examples are that production rates of excavation – unclassified increase when quantities and the number of units of available equipment increase and that production rates of plant mix surfacing in rural areas are higher than those in urban areas.

In this study, a production rate-based method was proposed to evaluate contractor performance. Based on the historical data of each controlling activity, a three-tier categorization (i.e., high performance, medium performance, and low performance) was suggested for each activity. Monte Carlo simulation was used to establish a distribution for each tier in order to make distinctions among the three tiers. For a specific project, contractors can be evaluated based on categorizations of those activities relevant to the project.

Based on the results of the descriptive and predictive analysis, an MS Excel based Production Rate Estimation Tool (PRET) was developed to help MDT practitioners obtain production rate information and estimated production rates based on historical performance data.

A second phase of this project will include the development of construction sequence logistics for major types of MDT projects using historical data available in daily work reports in order to enhance MDT's current contract time determination procedures. This work will be conducted in conjunction with [NCHRP Project 08-114 - Systematic Approach for Determining Construction Contract Time: A Guidebook](#).

For more information, contact Sue Sillick ([ssillick@mt.gov](mailto:ssillick@mt.gov), 406.444.7693).



## Fiber-Reinforced Asphalt Cement (FRAC)

<https://www.mdt.mt.gov/research/projects/fiber-rac.shtml>

In the fall of 2018, the MDT elected to incorporate synthetic fibers as an additive to improve asphalt cement (AC) properties on a project in the city of Billings. This is the first trial in the state that has used AC fiber reinforcement in a pavement preservation application. The intent of this chosen admixture is to improve resistance to cracking and rutting, and provide a higher dynamic modulus and increased service life.



**Sasobit Coated Aramid fibers**

The selected fiber 'Aramid' belongs to a family of synthetic products characterized by strength (some five times stronger than steel on an equal weight basis) and heat-resistance (some more than 500 degrees Celsius). The word aramid comes from a blend of the words "aromatic" and "polyamide".

Surface Tech (ST) was the chosen vendor to supply Ace Fiber (pre-treated aramid fibers coated with sasobit wax) used in the production of fiber-reinforced asphalt cement (FRAC).

ST was on site to monitor the inclusion of the Ace Fiber at the AC hot plant. ST also furnished the Ace Fiber Line-Vac delivery System which is the device that proportionally introduces the fibers into the drum mixer during AC production. It is estimated that over 18 million Aramid fibers are dispersed for each ton of mix to provide 3-dimensional reinforcement.



**Line-Vac fiber delivery System**

Because untreated aramid fiber is a very lightweight and difficult material to work with, the fibers are soaked in a sasobit wax binder. This pre-treatment adds weight to the fiber bundles (or clips) and prevents them from blowing away or clumping during the delivery and feeding process; If untreated, the fibers do not distribute evenly in the plants mixing chamber.



**Fibers entering the drum mixer**

The reinforced asphalt cement was produced by a Gencore Ultraplant 400 located at the Knife River Commercial Hot Plant in Billings. The paving contractor stated no issues during AC placement with the fiber admixture.

For more information please contact Craig Abernathy ([cabernathy@mt.gov](mailto:cabernathy@mt.gov), 406.444.6269).



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MONTANA DEPARTMENT OF TRANSPORTATION  
RESEARCH PROGRAMS

### Traffic Safety Culture Pooled Fund Program

<https://www.mdt.mt.gov/research/projects/trafficsafety.shtml>



The Montana DOT has led a pooled fund on traffic safety culture for five years. Fourteen states contributed funds to this pooled fund and 10 projects will be completed with this initial funding. The current participants would like to run this pooled fund for another five years.

To this end, below you will find information on a webinar to discuss the current pooled fund (TPF-5(309), <https://www.pooledfund.org/Details/Study/558>) and the upcoming pooled fund (1482, <https://www.pooledfund.org/Details/Solicitation/1482>).

**Webinar:** Traffic Safety Culture: Review of Phase 1 Accomplishments and an Invitation to Join Phase 2 of this Pooled Fund Program

**Date:** May 9, 2019

**Time:** 12:00 pm to 1:00 pm MT/2:00 pm to 3:00 pm ET

**Cost:** Free

**Organization:** Center for Health and Safety Culture, Montana Department of Transportation

Growing “traffic safety culture” has been identified as a core strategy by the USDOT Safety Council, FHWA’s Joint Safety Strategic Plan, the National Towards Zero Deaths (TZD) Safety Initiative, and the Road to Zero Coalition. Growing a positive traffic safety culture can support

traffic safety goals by reducing risky behaviors and increasing protective behaviors; it can also increase public acceptance of other effective traffic safety programs.

In 2014, the Montana Department of Transportation (MDT) initiated a five-year transportation pooled fund program on traffic safety culture, partnering with the Center for Health and Safety Culture (CHSC) at Montana State University as the principal research entity. This program began as a cooperative effort among participating state DOTs and other (traditional and non-traditional) stakeholder organizations sharing a vested interest in the role of traffic safety culture to achieve the Toward Zero Deaths (TZD) vision.

Given the success of the current pooled fund program, the members have decided to continue another five-year cycle to begin October 1, 2019. This webinar will introduce the pooled fund program to state DOTs and other traffic safety stakeholders interested more information or wishing to participate in the new funding cycle.

[Register for this webinar.](#)

For more information, contact Sue Sillick, ([ssillick@mt.gov](mailto:ssillick@mt.gov) 406.444.7693).



## **LIBRARY CORNER**

### **Library Customer Appreciation Day 2019**

<http://www.mdt.mt.gov/research/unique/services.shtml>

The theme of National Library Week 2019 is Libraries = Strong Communities. This theme highlights the valuable role libraries and librarians play in providing critical resources, programs, and expertise.

The Montana Department of Transportation library is a resource of its agency, but it is also part of a much larger community. At its most local level the library works with MDT staff to answer questions, solve problems and provide research services. Within the state of Montana, it is part of the Montana Shared Catalog through the State Library and as such has an impact on the state wide library community. Some of the libraries we intersect with include the State Library, the state Law Library and academic libraries throughout Montana.

The whole state! That seems like a very large community! Of course, we haven't even touched on the materials we send out of the state to support Interlibrary Loan requests. Those span the nation, as does our integration with the TRB Standing Committee on Library, and Informational Services for Transportation (LIST).



**National Library Week Poster**



**Library Customer Appreciation Day**



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### MONTANA DEPARTMENT OF TRANSPORTATION RESEARCH PROGRAMS

We participate with the AASHTO Research Advisory Committee (RAC) and with other transportation libraries around the world through the Tran-Lib listserv. Also, the local materials we send to the National Transportation Library (NTL) for greater distribution through their Rosa-P Database have an international reach and we even build Libguides for the Transportation Knowledge Networks (TKN) to keep the flow of information in developing areas of research current for anyone who needs it.

For such a small library our community is vast, and that is something of which to be proud.

This year at the Montana Department of Transportation Research Library our local National Library Week took the form of customer appreciation and education for the MDT staff.

We shared information in the form of a Giant life-sized board game, and a database petting zoo. We gave guidance in Overdrive, TRID, Rosa P and our internal library catalog where the librarian helped employees learn how to take advantage of these databases for research and professional development.

Library Customer Appreciation Day was an exciting opportunity to showcase our collection, advertise online training, and raise awareness of the value and impact of research in our community, a community that starts locally but has a reach that is far larger than meets the eye.

For additional information, please contact Bobbi deMontigny ([bodemontigny@mt.gov](mailto:bodemontigny@mt.gov), 406.444.0871).

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## Library Training On Demand

<http://www.mdt.mt.gov/research/unique/services.shtml>

Traditionally, employees of the Montana Department of Transportation (MDT) have had an introduction to research and library services during orientation. This is a great start for our employees, but orientation can be an overwhelming time. They are given so much new information that when the time comes to actually use the library, they might need a refresher course.



The MDT has been working on an enhanced training platform for their employees. Known in educational institutions as a Moodle, this e-learning format is often used for distance education and self-paced learning. Branching out of universities and into workplaces and other sectors, this module-based learning format allows our employees to take new training courses electronically.

Now employees can review the information they learned in orientation, develop deeper information literacy skills and confidence to access library materials when they need them most. The library should never be a barrier to information. It should be easy for employees to access the resources they need to get the job done!

For more information, please contact Bobbi deMontigny ([bodemontigny@mt.gov](mailto:bodemontigny@mt.gov), 406.444.0871).



**DID YOU KNOW?**

**Research Program and Project Management (RPPM) Website**

<http://rppm.transportation.org/Pages/default.aspx>

The Research Program and Project Management website enables the transportation research community to discover best practices, ask questions, collaborate on shared issues, and more. It is organized around the research cycle as follows:

- **setting the research agenda**
- **carrying out research**
- **delivering results/communicating value**
- **collaborating in research activities**

The site offers a calendar that includes research funding deadlines, and links to conferences, meetings, webinars, and workshops. In addition, it offers links to information clearinghouses and other resources. This site is comprehensive in addressing the varied needs of anyone involved in research project and program management and allows for communication coordination, and collaboration.

For questions or comments, please send an e-mail to [MyTRB@nas.edu](mailto:MyTRB@nas.edu).

**CALENDAR OF EVENTS**

**May**

- TCRP IDEA Proposals Due- 5/1
- NCHRP Synthesis Panel Nominations Due- 5/3
- MDT RRC Meeting- 5/23

**June**

- NCHRP 2020 FY Panel Nominations Due- 6/15
- TCRP Problem Statements Due- 6/17
- MDT RRC Meeting - 6/25
- TCRP Synthesis Panel Member Nominations Due- 6/30

**July**

- BTSCR Panel Member Nominations Due- 7/22
- RAC Summer Meeting- 7/22-7/25
- MDT RRC Meeting- 7/30
- NCHRP Synthesis 2019 FY Panel Nominations Due- 7/31

**August**

- MDT RRC Meeting - 8/30

**September**

- NCHRP IDEA Proposals Due- 9/4
- ACRP Topics Due- 9/6
- ACRP Legal Topics Due- 9/13
- Rail-Safety IDEA Program Proposals Due- 9/15
- NCHRP Legal Topics Due- 9/17
- MDT RRC Meeting- 9/26

**October**

- ACRP Synthesis Topics Due- 10/7
- MDT RRC Meeting- 10/30



For additional information, please see: <http://rppm.transportation.org/Lists/Calendar/calendar.aspx>.



## NEW RESEARCH PROJECTS

[Developing a Methodology for Safety Improvements on Low-Volume Roads in Montana](#)

[Guidance for Evaluating Traffic Safety Culture Strategies](#)

[Guidance on Messaging to Avoid Reactance and Address Moral Disengagement](#)

[Key Information for DUIC Policy](#)

[Traffic Safety Citizenship Communication Tools](#)

[Traffic Safety Culture Primer](#)

## NEW RESEARCH REPORTS

[Effective Production Rate Estimation Using Construction Daily Work Report Data](#)

A listing of all past and current research projects can be found at

[http://www.mdt.mt.gov/research/projects/sub\\_listing.shtml](http://www.mdt.mt.gov/research/projects/sub_listing.shtml)

## NEW EXPERIMENTAL PROJECTS

[Electric Wildlife Mat \(EWDM\) Evaluation](#)

[Tencate-Mirifi MPV400 Polypropylene Nonwoven Geotextile](#)

## NEW EXPERIMENTAL REPORTS

[Chip Seal as Interlayer to Retard Reflective Cracking](#)

[Crack Sealing Milled Asphalt Pavement Prior to Overlay](#)

[Geosynthetic Reinforced Soil \(GRS\) IBS Technology](#)

[Smart Cushion innovations \(SCI\) 100GM Crash Attenuator](#)

[Wet-Reflective Bead Technology Pavement Marking - Rockvale Laurel](#)

A listing of all past and current experimental projects can be found at

[http://www.mdt.mt.gov/research/projects/exp\\_sub\\_listing.shtml](http://www.mdt.mt.gov/research/projects/exp_sub_listing.shtml)





## REMINDER

Information on research services and products, such as research and experimental project processes and reports and technology transfer services, can be found on the Research web site at [www.mdt.mt.gov/research](http://www.mdt.mt.gov/research).

MDT's library collection can be searched through the [library catalog](#). The catalog and other information resources are available through the [MDT Library web site](#).

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