Highway Safety Manual Training

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PREPARED BY:

Carlos Sun

Praveen Edara

Yaw Adu-Gyamfi

Mohammadmehdi Zoghifard

Ziyi Huang

University of Missouri-Columbia

PREPARED FOR:

Missouri Department of Transportation

Construction and Materials Division, Research Section

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Carlos Sun https://orcid.org/0000-0002-8857-9648
Praveen Edara https://orcid.org/0000-0003-2707-642X
Yaw Adu-Gyamfi https://orcid.org/0000-0002-1924-9792
Mohammadmehdi Zoghifard
Ziyi Huang</td><td colspan="2">8. Performing Organization Report No.</td></tr>
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Department of Civil and Environmental Engineering
University of Missouri-Columbia
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Columbia, MO 65211</td><td colspan="2">10. Work Unit No.</td></tr>
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Safety has become an area of increasing focus in all aspects of transportation planning, design, construction, and operations. Transportation legislations, such as the SAFETEA-LU Act (2005) and the FAST Act (2015), have promoted data-driven safety analysis in various programs. The publication of the Highway Safety Manual (2010) and the Supplement (2014) have standardized data-driven safety methodology and developed related tools such as spreadsheets and the ISATe (Enhanced Interchange Safety Analysis Toolbox). The demand for knowledge and experience in data-driven safety analysis has been increasing. This report documents a project to produce data-driven safety training for MoDOT trainers. The project developed two training deliverables. The first is a full-day training for safety staff and engineers. This training covers the fundamentals of data-driven safety, rural multilane divided highways, urban/suburban 4-leg signalized intersections, urban 4-lane freeway segments, and four sample applications: design exception, traffic impact study, design build, and safety programming. The second was a 15-minute video that presents an overview of data-driven safety and is suitable for staff at various levels, even those without formal safety training. A goal of this project is to produce flexible training materials that can meet the training needs of various MoDOT districts and divisions.</td></tr>
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Highway Safety Manual Training

MoDOT Research Project TR201908

Principal Investigator
Carlos Sun, Ph.D., P.E., J.D.
Professor Department of Civil and Environmental Engineering
University of Missouri-Columbia

Co-Principal Investigator
Praveen Edara, Ph.D., P.E.
Professor
Department of Civil and Environmental Engineering
University of Missouri-Columbia

Yaw Adu-Gyamfi, Ph.D.
Assistant Professor
Department of Civil and Environmental Engineering
University of Missouri-Columbia

Mohammadmehdi Zoghifard
Ph.D. Student
Department of Civil and Environmental Engineering
University of Missouri-Columbia

Ziyi Huang
M.S. Student
Department of Civil and Environmental Engineering
University of Missouri-Columbia

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Abstract

Safety has become an area of increasing focus in all aspects of transportation planning, design, construction, and operations. Transportation legislations, such as the SAFETEA-LU Act (2005) and the FAST Act (2015), have promoted data-driven safety analysis in various programs. The publication of the Highway Safety Manual (2010) and the Supplement (2014) have standardized data-driven safety methodology and developed associated user-friendly tools such as spreadsheets and ISATe (Enhanced Interchange Safety Analysis Toolbox). The demand for knowledge and experience in data-driven safety analysis has been increasing. This report documents a project to produce data-driven safety training for MoDOT trainers. The project developed two training deliverables. The first was a full-day training for safety staff and engineers. This training covered the fundamentals of data-driven safety, rural multilane divided highways, urban/suburban 4-leg signalized intersections, urban 4-lane freeway segments, and four sample applications: design exception, traffic impact study, design build, and safety programming. The second was a 15-minute video that presents an overview of data-driven safety and is suitable for staff at various levels, even those without formal safety training. A goal of this project is to produce flexible training material that can meet the training needs of various MoDOT districts and divisions.

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Introduction

1.1 Overview

One of MoDOT's tangible results is moving Missourians safely. This implies reducing the risk of fatalities and serious injuries that Missourians experience while traveling on Missouri's transportation network. One approach for furthering this tangible result is the use of data-driven safety methods. Such methods help to estimate the expected safety performance of various facilities, countermeasures, and projects. These estimates can then be used to optimize the use of MoDOT’s limited resources by revealing those investment decisions that would produce the most return of safety benefits and maximize the number of lives saved on Missouri roadways.

1.2 Report Outline

This report summarizes the safety training developed in this project. Chapter 2 covers the full day workshop including modules on fundamentals, rural multilane divided highways, urban/suburban 4-leg signalized interesections, and urban 4-lane freeway segements. Chapter 3 discusses the high level overview video. Chapter 4 presents suggestions for the use and delivery of the training materials.

1.3 Overview

The full day workshop is intended to quickly train staff to become proficient in data-driven safety analysis. This is accomplished via the following three steps. The first is the presentation of the fundamentals of safety, including a discussion on the challenges of safety analysis and the benefits of data-driven safety. The second is a series of three active learning exercises involving common types of roadway facilities: urban multilane divided highways, urban/suburban 4-leg signalized intersections, and urban 4-lane freeway segments. The third is the review of four common data-driven safety applications: design exception, traffic impact study, design build, and safety programming. Table 2-1 shows these three steps implemented in five separate modules.

Table 2-1 Full Day Workshop Topics

#	Module Title	Subjects
1	Fundamentals of Data-Driven Safety Analysis	• motivation for data-driven safety • subjective vs. objective safety • regression to the mean bias • statistics background
2	Rural Multilane (RML) Divided Highways	• data and modeling of RML • Centertown US-50 example
3	Urban 4-Leg Signalized Intersections (U4SG)	• required and optional data for U4SG • Salem US-32/MO-19 example
4	Urban 4-Lane Freeway Segments	• freeway safety methodology • freeway segmentation • Lebanon I-44 example
5	Example Applications of Data-Driven Safety	• design exception • traffic impact study • design build • safety programming

The entire workshop can be accessed via: https://extensionmissouri.instructure.com/enroll/RGR7RN. The link will take learners to the University of Missouri Extension website, where they can set up a profile (name and email address). From there, they will be directed to the Canvas course.

Table 2-2 shows a tentative timeline for these modules as implemented for online, self-paced delivery. In-person training or hybrid training (online + in person) can adjust these timelines accordingly. Please note that in-person training is more dynamic than the online video lectures. An instructor should consider allocation much more time than the length of the recorded videos in order to accommodate student questions. The length of time devoted to the various modeling exercises can depend on class progress. For example, an initial 20 minutes can be given and then the instructor can extend the time as needed. The various training delivery options such as in person, Canvas assisted, hybrid, online + facilitator, and self-paced, are discussed further in Chapter 4.

Table 2-2 Full Day Workshop Tentative Timeline

#	Module Title	Content
1	Fundamentals of Data-Driven Safety Analysis	• video 1 - ~10 minutes • video 2 - ~10 minutes • video 3 - ~10 minutes • video 4 - ~20 minutes • 4 quizzes, one after each video • 1 spreadsheet exercise • suggested total time = ~2 hours
2	Rural Multilane (RML) Divided Highways	• video 1 - ~10 minutes • video 2 - ~15 minutes • RML modeling exercise • suggested total = ~1 hour
3	Urban 4-Leg Signalized Intersections (U4SG)	• video 1 - ~13 minutes • video 2 - ~9 minutes • video 3 - ~14 minutes • U4SG modeling exercise • suggested total = ~1.5 hours
4	Urban 4-Lane Freeway Segments	• video 1 - ~8 minutes • video 2 - ~9 minutes • video 3 - ~7 minutes • video 4 - ~12 minutes • urban 4-lane freeway modeling exercise • suggested total = ~2 hours
5	Example Applications of Data-Driven Safety	• video 1 - ~11 minutes • video 2 - ~11 minutes • video 3 - ~ 11 minutes • video 4 - ~13 minutes • applications quiz • suggested total = ~2 hours

1.4 Fundamentals of Data-Driven Safety

Before diving into specific data-driven safety methods such as the use of the Highway Safety Manual, it is useful to first review some background information. Specifically, the module covers the advantages of such methods and the theory behind them. Then the module discuss how the process of analyzing traffic safety is a complicated process requiring an organized approach.

The following five learning objectives are achieved. The first is a presentation of the background and motivation for using data-driven safety methods. The second is a comparison of subjective versus objective safety. The third is a discussion on the complexity of traffic crashes and associated data. The fourth is a review of fundamental statistical concepts such as sampling distributions and the regression to the mean bias. The last is an outline of the use and application of data-driven safety methods.

1.5 Rural Multilane Divided Highways

In learning data-driven safety methods, it is often helpful to progress from simpler to more complicated facilities. Rural multilane segments or RML is one of the simpler facilities to analyze. This training only covers divided roadways as it is rare to have rural multilane roadways in Missouri that are undivided. The safety analysis methodology is presented first, followed by the Centertown US-50 example.

The following are the four learning objectives of this module. The first objective is to introduce HSM methodology for RML. The second is to review the data requirements for safety analysis. The third is to present the Centertown US-50 example for workshop attendee exploration. The last is to present a sample solution for the Centertown US-50 example.

1.6 Urban 4-Leg Signalized Intersection

Signalized intersection facilities involve different turning movements and signal phasing. The safety analysis of intersections requires the details of the intersection geometrics as well as the surrounding land-use. In contrast to segments, intersections involve a limited area centered around the intersecting roads. This workshop training presents the methodology for urban 4-leg signalized intersections. Other types of intersections, such as rural, 3-leg, and stop-controlled, are similar. The urban 4-leg signalized intersection methodology is illustrated via the MO-32/MO-19 intersection example in Salem. The workshop attendee is asked to attempt the analysis first before reviewing the sample solutions.

The four learning objectives for this module are as follows. The first is to introduce the safety methodology for analyzing urban 4-leg signalized intersections. The second is to review the required data for safety analysis. The third is to review the desired or optional data for safety analysis. The fourth is to practice using the Salem US-32/MO-19 example. The last is to explain the sample solution for the Salem US-32/MO-19 example.

1.7 Urban 4-Lane Freeway Segments

Freeway facilities are access-controlled roadways that are capable of servicing a high flow rate. Since freeway interchange facilities are complex and involve terminals, ramps, and speed change lanes, it is important to analyze freeway segments separate from the interchange influence. This current training focuses on the example of urban 4-lane freeway segments. Other types of freeway segments, such as rural 4-lane and urban 6-lane, have similar analysis procedures. The urban 4-lane freeway methodology is illustrated via an example from I-44 in Lebanon. The workshop attendee is asked to attempt the analysis first before reviewing the sample solutions.

This module involves the following five learning objectives. The first is to introduce the safety methodology for analyzing urban 4-lane freeway segments. The second is to present the freeway segmentation process. The third is to review the required data for safety analysis. The fourth is to discuss the I-44 Lebanon example. The last is to explain the I-44 Lebanon solution.

1.8 Applications of Data-Driven Safety Methods

The data-driven safety methods in this workshop could be applied to a variety of situations. The SAFETEA-LU Act (2015) and subsequent transportation authorizations have emphasized safety more and more. The publishing of the national Highway Safety Manual in 2010 and the supplement in 2014 have provided uniform guidance and data-driven methods to help improve safety analysis. Improved safety analysis can be incorporated into various aspects of transportation planning, design, and operations. This module presents four common examples of the application of data-driven safety analysis. They are design exception, traffic impact study, design build, and programming.

This module covers the following four learning objectives. The first is a discussion of how data-driven safety methods can demonstrate the substantive safety of design exceptions. The second is an examination of how traffic impact studies can include data-driven safety analysis. The third is an exploration of how data-driven safety fits with the design/build innovative contracting method. The last is an explanation of how data-driven safety methods can be incorporated into various types of safety programming.

Data-Driven Safety Overview Video

An approximately 15-minute long video presents the background and motivation of data-driven safety analysis and its practical benefits. The video is presented at a high level and is appropriate for staff at various roles and positions, even those without formal safety training.

Note that the on screen poll at around the 3:24 mark requires the viewer to click on the ⓘ symbol that appears on the top right of the screen. An associated question text might also appear, depending on the browser and browser settings. The video is initially accessible via a YouTube channel: https://youtu.be/RviwzwpKTpA.

This video can be easily delivered via other methods besides YouTube.

Conclusion and Training Delivery Recommendations

By the end of the workshop, the attendee is expected to understand the motivation and benefits of data-driven safety analysis, become proficient with the analysis of three common types of facilities, and be familiar with four different applications. This workshop serves as a foundation from which an attendee could explore other types of facilities and apply the workshop safety methodology to address tasks in the course of the attendee's regular job duties.

The PowerPoint slides used in the course are available to the attendee but with blanks throughout. This form of skeletal slides is recommended by various education researchers who advocate for active learning and participation in lecture delivery. A fully completed set of slides and a copy of the overview video are available via a Box account for downloading. An invitation for downloading from Box was sent to the MoDOT technical advisory group.

The delivery of this workshop can be accomplished in various ways. The workshop material is available via a self-contained online course delivery system named Canvas. Canvas is a popular learning technology platform with various capabilities such as course organization, video delivery, e-document storage, and automated quizzing. Canvas is the learning technology used by the entire University of Missouri system for the delivery of university courses as well as professional training via University Extension.

Having the entire workshop in Canvas offers the following options for delivery.

1. Deliver the course materials in person. Canvas serves as a repository for workshop slides and HSM spreadsheets.
2. Deliver the course materials in person but assisted by Canvas. Canvas serves as a supplementary source of instruction review.

3. Deliver the course in a hybrid fashion where in-person and online sub-modules could be used in a complementary fashion. For example, a trainer could use an online sub-module to present the background and methodology for modeling freeway segments. The trainer can then cover the Lebanon I-44 example in person and circulate around the training room to address individual questions.
4. Deliver the course mostly online but provide an in-person facilitator to organize learning groups and to answer questions.
5. Deliver the course as an entirely self-paced online course. This option is the most accessible statewide and can occur at any time; however, feedback occurs only online.

Trainers can customize the workshop material and deliver it in a way that is the most suitable to their preferences. The customization could be due to such reasons as scheduling, educational philosophy, or personal preferences. Even though this workshop was originally intended to be for training trainers, it can also be used to train attendees directly. The University of Missouri Extension program can assist with the delivery and registration of attendees using the Canvas platform. An agreement can be established with Extension to manage future trainings outside the scope of the current project.

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