Highway Traffic Monitoring Committee (ACP-70)

Research Subcommittee: 2023/2024 Completed and Ongoing Research Projects

TRAFFIC DATA COLLECTION

Assessing and Enhancing the Traffic Count and HPMS Program

The objective of this project is to assess the adequacy of the Oklahoma Highway Pavement Monitoring System (HPMS) program and enhance it by potentially adding new sites and removing unnecessary locations, and incorporating emerging technologies and data sets to reduce data collection costs. The study will: • Evaluate whether the current traffic count locations represent the full extent of Oklahoma HPMS roadways. • Collaborate with local governments and MPOs to investigate the integration of their data into the Oklahoma Department of Transportation (ODOT)'s count program to meet HPMS reporting needs. • Determine whether continuous count locations are adequate for factoring short-term traffic counts. • Review emerging technologies and data sources that may be appropriate for Oklahoma HPMS reporting. This research project aims to directly support the assessment and improvement of traffic count and HPMS Programs at ODOT. It also seeks to identify emerging traffic data collection technologies and cost-effective data sources suitable for ODOT's HPMS and census reporting purposes. Maximizing the utility of traffic data collection is crucial for meeting HPMS/census reporting needs.

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Start Date: 10/01/2024
Expected Completion Date: 03/31/2026
Status: Active
URL: https://trid.trb.org/View/2434118

Development of an Evaluation and Acceptance Process for Traffic Count Devices

As new traffic count device technologies emerge, it is crucial to establish guidelines for their evaluation and acceptance for use by the Virginia Department of Transportation (VDOT). These guidelines should consider factors such as count accuracy and reliability. Having guidelines will ensure that the most effective and efficient technologies are implemented for traffic monitoring and management. This project aims to develop an evaluation process for assessing the suitability of traffic count sensors for traffic monitoring purposes. The methodology will be tested and validated using a vision-based classification device as a pilot. The potential implementation of this research is that the Traffic Operations Division (TOD) can utilize the research results to establish an official traffic count device verification and acceptance procedure. This standardized procedure can be applied to all future traffic count devices seeking verification for use by VDOT.

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Expected Completion Date: 05/31/2026
Status: Active
URL: https://trid.trb.org/View/2433965

National Traffic Sensor System Evaluation Program

Traffic sensors are essential components of all highway traffic monitoring and traffic management systems and reporting. Traffic monitoring depends upon reliable detection and accurate measurement of flow rate, speed, classification, and other parameters for various modes of transportation. Active traffic management systems and other intelligent transportation systems applications require these parameters and more for varied uses like traffic control systems, wrong-way driving detection, near-miss crash analysis, and predictive analysis. Sensor systems based on new and emerging technologies—such as optics, electronics, communications, artificial intelligence, and connected and autonomous vehicle (CAV) applications—are rapidly supplanting traditional traffic sensor systems, but they typically lack independent evaluation of their accuracy and performance. State and local agencies must often rely on informal, inconclusive evaluations and pilot deployments to assess sensor systems' suitability for highway applications. The burden to test every sensor type and revision that comes to market creates massive duplication of effort and wastes time, effort, and funding. Although millions of traffic sensors are in use, manufacturers and distributers can rarely provide independent third-party test results demonstrating their real-world performance. Sensor errors can seriously affect safety, mobility, and public trust. The lack of information regarding system performance and reliability in different operational domains can lead to misapplication of sensor systems, unacceptable performance, or short service life. An authoritative method and a national testing program are needed to characterize the performance and identify the operational domains of current and emerging traffic sensor systems. The objective of this research is to develop evaluation criteria and testing methods for traffic monitoring sensors and systems, which could serve as the foundation for a national sensor system evaluation program.

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Start Date: 09/03/2024
Expected Completion Date: 03/02/2027
Status: Active
URL: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5307

Deployment of LiDAR Based Detection Sensors at Road Intersections for Improved Pedestrian &Traffic Monitoring

The Purdue team has been working with the Indiana Department of Transportation (INDOT) for several years on using LiDAR technology for mapping highways and estimating stockpile volumes in salt storage facilities. In the last few years, the application of LiDAR technology has expanded to include permanent installation at intersections for pedestrian/traffic monitoring. This project will assist INDOT in deploying and analyzing LiDAR technology at intersections.

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Start Date: 20240801
Expected Completion Date: 20260131
Status: Active
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Development of Accurate and Reliable Average Annual Daily Traffic (AADT) Factoring Methods

According to the Federal Highway Administration (FHWA), "Annual Average Daily Traffic (AADT) estimates, with as little bias as possible, the mean traffic volume across all days for a year for a given location along a roadway". AADT provides crucial information about road activity in terms of vehicular volume (i.e., vehicles per day) on specific road segments. As such, it plays a pivotal role in supporting highway agency activities that include planning, design, maintenance, operations, safety, environmental analysis, finance,

engineering economics, and performance management. Moreover, AADT serves as a key parameter for the allocation of funds to state Departments of Transportation (DOTs). Nebraska DOT (NDOT) is required to collect and report AADTs to the FHWA annually as part of the Highway Performance Monitoring System program, as well as make these data publicly available. This is because AADTs are used by a wide range of stakeholders in Nebraska, including NDOT divisions, city traffic engineers, and private consultants. Therefore, providing accurate AADTs is imperative, while using inaccurate AADTs in one or more of the mentioned studies would result in direct economic losses for the state.

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Validation of Freight Volume Modeling on Major Highway Links

One of the most challenging problems in urban transportation planning is the lack of fine grain data on freight movements. Cities and regions do not know how many trucks operate in the region and have only limited information on freight flows. A particularly important information problem is the absence of a consistent and current source for freight volume and origin-destination data. Without such information, it is difficult to manage or plan for freight in metropolitan areas. This research seeks to develop a method for generating freight (truck) volume and origin-destination estimations at the traffic analysis zone level from streamed data so that estimations can be constantly updated. With our PSR-4 proposal titled "Freight Volume Modeling on Major Highway Links" we have proposed to use existing freight data sensors (e.g., WIMS, CCTV) to validate the feasibility of freight volume estimation on links on a region of interest (ROI), approximately 12 square miles in size, north of the Ports of Los Angeles and Long Beach. Specifically, we seek to validate if freight modeling is (1) feasible and (2) can be automated.

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Status: Completed
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Guide for Long-Term Automatic Traffic Signal Performance Measurement Systems Applications

Automated traffic signal performance measures (ATSPMs) could provide additional information to DOTs to help improve signal performance at intersections. ATSPM systems primarily present raw data in graphic representation to provide visual tools to assist signal operators in assessing signal performance on a regular basis, proactively identifying problems associated with signal timing, and to seek opportunities for improving traffic signal operation to improve traffic flow and system efficiency. However, ATSPMs user experiences have identified limitations of the current high-resolution data schema on which the ATSPMs are established including: (1) The unavailability of a universal schema or easy conversion from one data format to another for different types of systems, causing state DOTs and public agencies to duplicate their effort in creating and managing data and information. In addition, due to limited standardized guidelines about managing high-resolution signal data and associated metadata information, state DOTs and other public agencies may handle complex traffic signal system cases slightly different, which can lead to inconsistent methodologies between agencies. (2) Connected automated vehicles (CAV) and sensor technology, a new data source of short-term trajectory information as vehicles and pedestrians approach an intersection, are currently not

included in the data schema for ATSPMs. (3) The unavailability of a well-documented standard available for recording geo-spatial metadata. Research is needed to define effective practices for state DOTs and public agencies for managing ATSPM data long-term and ensure these practices are scalable, transferable, and enable CAV integration. The objective of this research is develop a guide to assist state DOTs and public agencies with long-term management of ATSPM systems applications for scalability, transferability, and CAV integration.

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Expected Completion Date: 10/15/2026
Status: Active
URL: https://rip.trb.org/View/1854167

Developing a Low-Cost Open-Source Traffic Counter for Rural Areas (CTRA)

This research addresses operational disconnects and knowledge gaps related to traffic data collection in rural areas by developing a low-cost 3D-printed and open-source traffic counter (CTRA). Conventional pneumatic tube-based systems, which are still in use by transportation agencies across the United States because of their affordability, simply do not work on gravel roads and have difficulty counting non-motorized users and differentiating non-traditional vehicles from conventional motor vehicles. CTRA was developed and field tested at the University of Alaska Fairbanks and designed to provide a video-based data collection system that overcomes the limitations of other traffic counting devices. A count rate of 100% was achieved during the calibration process. Other than electronic hardware, most pieces of hardware can be printed on a 3D printer to form a simple and robust case and mounting system and only straps are needed to secure the counter to a fixed object. Because of its relatively simple and affordable design, CTRA could also be used for STEM and educational activities in schools and other related programs.

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Status: Completed
URL:
https://cset.uaf.edu/research/year-3-projects/developing-a-low-cost-open-source-traffic-counter-for-rural-areas-ctra/

AADT Estimation and Validation Tools for Local Off-System Public Roads

Per the Fixing America's Surface Transportation (FAST) Act of 2015, states are to have estimated Annual Average Daily Traffic (AADT) values on every paved road in the state by September 30, 2026. This will allow the Idaho Transportation Department (ITD) and local agencies the ability to better model safety. ITD has been tasked with coming up with an accurate and reliable mechanism to estimate traffic on every road in the state. ITD's existing traffic counting program covers all "federal aid" roads within Idaho but does not extend to local, rural, and other off-system routes. The need for expanded traffic counts (or volume estimates) is driven, in part, by the federal recommendations for roadway data collection described in the Model Inventory of Roadway Elements (MIRE). MIRE includes a set of roadway characteristics and traffic inventory elements that are considered critical to safety management. Currently, ITD maintains AADT estimates on approximately 12,000 centerline miles of roadway. This requirement extends that an additional 44,000 centerline miles on which ITD needs to establish an AADT estimate. In addition to federal recommendations, the expanded counts (or volume estimates) are requested for all public roads by ITD's

traffic safety group to use for crash analytics. The objective of this project will be to develop comprehensive implementation and validation processing tools for estimating AADT values on every local non-federal aid public (off-system) road in Idaho using a geospatial interpolation methodology, ArcGIS, and Python.

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Expected Completion Date:
Status: Programmed
URL: https://rip.trb.org/View/2298710

Exploring and Developing Innovative Methods for Estimating VMT on Local Roads in Texas

State agencies must report vehicle miles traveled (VMT) estimates for local roads compiled in the statewide summaries dataset of the Highway Performance Monitoring System (HPMS) database. While the VMTs for higher functional class roads are the product of annual average daily traffic (AADT) with the corresponding roadway segment length (L); the states produce the VMT estimates for local roads as an aggregate measure using a variety of methods. Currently, the local road network accounts for more than two-thirds (67%) of the total roadway mileage in Texas and is the largest in the United States. Conducting short-term counts (STCs) (e.g., for a few hours up to a few weeks) on an extensive local road network to develop VMT is financially challenging; hence, Texas Department of Transportation (TxDOT) uses statistical methods to obtain aggregated VMT. Although the current methods are statistically verified, they are yet to be revised and validated. The research team will investigate and develop data-driven methods for VMT estimation that can be implemented in Texas and provide significant savings to TxDOT. The developed methods will also reduce any bias in the estimation of VMTs on local roads that can lead to the overestimation or underestimation of travel demand.

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Start Date: 05/09/2023
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Status: Active
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Strategies for Developing and Using Data Ontologies for Data-Driven Decision-Making

State departments of transportation (DOTs) have long collected and used data to inform decisions and to manage assets and programs. Much of the data are managed using legacy systems that lack interoperability and are difficult to access and update. These systems continue to be used because they are highly relevant for their intended use and well understood by those who have years of experience using them. However, they may be less useful for decisions that cut across functional areas, involve multiple modes, engage with external partners, or require integration with modern data technologies. In many decision-making contexts, legacy systems can hamper cross-cutting analysis and require extensive investigation of metadata to ensure that the results of an analysis are meaningful for the decision at hand. A common approach to making legacy systems more amenable for cross-functional decisions is to develop a ‘data lake' or ‘data warehouse', moving all agency data to a single, enterprise-level platform. While this approach can provide agency-wide access, it does not address differences in data models or the need for a cross-functional, shared understanding of the meaning of the data. The shift to performance-based management and the need to respond quickly in emergent conditions has made data-driven decision-making imperative for state DOTs. This requires a data governance and management perspective that elevates data as an asset, with the same priority as traditional physical transportation assets. This perspective requires data representations that include data ontologies,

glossaries, taxonomies, registries, catalogs, metadata, and models. Data ontologies are a key element in data representation. A data ontology describes the core information concepts represented in the data that, in turn, drive the business processes and the relationships among the concepts. An ontology ensures not only consistent naming across disparate disciplines, organizations, and information technology systems, but consistent meaning across users. For example, data about a highway bridge would not only include bridge components—superstructure, substructure, and deck—but also traffic volumes carried, noise propagation to nearby receptors, hydrologic conditions below the bridge, stormwater runoff, use of the bridge by birds or bats, maintenance history, construction and maintenance costs, and cultural or historic value of the bridge to a community. Taken together, these interrelated data provide a holistic view of the bridge and its context; a view that can better inform decision-making. A well-designed ontology allows these data to be discovered, integrated, analyzed, and understood by all users without resorting to ad hoc methods that may produce unreliable results and different interpretations. This common understanding of the meaning of the data also supports nimble, multidisciplinary teams that are prepared to collaborate to analyze the data and provide leadership with the best available information to formulate a response. Research is needed to identify effective practices for developing robust data ontologies and for building agency capacity to use them in transportation decision-making. The objective of this project is to develop a guide for state DOTs on strategies for implementing data ontologies that support nimble and efficient data-driven decision-making.

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Status: Active
URL: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5215

Leveraging Existing Traffic Signal Assets to Obtain Quality Traffic Counts and Enhance Transportation Monitoring Programs

State departments of transportation (DOTs), metropolitan planning organizations (MPOs), counties, and other local agencies manage extensive traffic counting programs and have a need to ensure that traffic count data covers a variety of modes of travel, e.g., cycling and walking. These counts support decision-making with the aim of enhancing safety and mobility for the traveling public. There are thousands of existing traffic detection assets throughout the nation that serve traffic management operations. Moreover, other customers of traffic count data such as traffic engineers, traffic monitoring staff, transportation and active transportation planners, and data scientists, as well as non-transportation stakeholders (e.g., those responsible for realty, billboards, economic development, etc.), need to combine traffic count data sets in new ways to support various business processes. As sensor detection technologies mature in assisting traffic operations and intelligent traffic system (ITS) programs, the providers of traffic count programs recognize the potential benefits of using existing infrastructure and data to supplement their counts. However, the diverse efforts underway are generally not summarized, publicized, or leveraged. Key issues associated with using the data from traffic signal equipment for traditional traffic volume measurement include (a) inconsistency in data quality and format that varies across vendors and technologies; (b) inconsistency in availability of sensors at all intersections as well as approaches to individual intersections; and (c) variable configuration of sensor equipment causing possible gaps in data availability, quality, and storage even though the equipment itself may be capable of counting vehicles, bikes, and pedestrians. Research is needed to examine whether the data provided by traffic signal assets can provide accurate traffic counts. The objectives of this research are to (a) determine the feasibility of using existing or enhanced traffic equipment to collect, store, and disseminate data for purposes other than traffic operations, particularly for traffic monitoring programs; (b) determine the suitability of traffic count data from already installed and existing traffic assets for this purpose; and (c) develop effective practices for obtaining and integrating traffic counts from existing traffic assets. The research will evaluate types of currently installed traffic monitoring assets and assess the suitability of traffic count data for non-operational traffic data usage. In this research, (a) the term "suitability" includes the

quality, applicability, and type of the data obtained from the traffic equipment; (b) the term "traffic" includes motorized vehicles, micro-mobility devices, and non-motorized modes including bicycles, pedestrians, etc.; and (c) the term "traffic assets" includes, but is not limited to, signalized intersections, crosswalk signals, video, loops, magnetometers, radar, and traffic detection cameras.

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Expected Completion Date: 03/28/2025
Status: Active
URL: https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5126

Anomaly Detection in Traffic Patterns Using INDOT Camera System

INDOT cameras at each highway location can provide lane-level traffic flow data from TASI's previous project. The primary goal for this project is to identify anomalies in traffic data patterns using a trained Neural Network, and store short video recordings of these anomalies as they are detected for review. The Neural Network can be trained using previously obtained week, month, or year traffic flow data and be used to distinguish in-distribution from out-of-distribution by comparing new data to the previous data.

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Start Date: 08/01/2023
Expected Completion Date: 11/30/2024
Status: Active
URL: https://rip.trb.org/View/2232915

Methods for Assigning Short-Duration Traffic Volume Counts to Adjustment Factor Groups for Estimating AADT

Commonly used methods for estimating AADT do not adequately address how short-duration counts should be assigned to adjustment factor groups. Also, there are concerns about the inherent errors in these methods, their applicability to roadways with insufficient traffic data, and the accuracy of the derived AADT estimates. There is a need to improve existing methods and develop new methods for functional classes of roadway where insufficient continuous counting exists to improve accuracy of AADT estimates. These methods will help transportation agencies improve the quality of traffic information and support the decisions regarding capital investment programs and budgets as well as design and maintenance programs. The objective of this research is to develop rational methods for assigning short-duration traffic volume counts to adjustment factor groups for estimating AADT. The research is concerned with all functional classes of roadways and traffic volumes. The project will be conducted in two Phases. Phase I: (1) Collect and review relevant literature; (2) Identify and prioritize the weaknesses and gaps in the methods; (3) prepare an updated, detailed work plan to be executed in Phase II; (4) Prepare an interim report that documents the research performed in Tasks 1 through 3. Phase II: (5) Execute the Phase II plan approved in Task 4. Propose improved and new methods for all functional classes of roadways and traffic volumes. Also, illustrate use of the proposed methods to obtain realistic estimates of AADT. (6) Prepare a final deliverable that documents the entire research effort.

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Start Date: 06/01/2021

Expected Completion Date: 4/3/2024
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URL: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4945

TDOT RDS Data Quality Assurance and High-Resolution Content Enhancement

The need to understand the state of traffic and its dynamics is only increasing on Tennessee's major roadways. Increasing passenger and freight demand is driving congestion and safety concerns. Tennessee Department of Transportation (TDOT) is taking major steps to address these concerns for the motoring public through capital projects, active traffic management strategies, and real time incident response. A major source of real-time roadway condition data in Tennessee is the RDS data system. Over 800 detectors across the state provide information on vehicle counts, classifications, and speeds. Crucially, they take high-fidelity measurements that are not available from many alternative sources, while being non-invasive for easy construction and maintenance. The challenge remains that powerful insights from the data can be hampered by suboptimal data quality and usability or availability limitations. Specific limitations that exist in the RDS data stream include degraded system uptime, short periodic data outages, a high degree of noise in data at some fidelity levels, and loss of sensor calibration over time.

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Start Date: 08/01/2022
Expected Completion Date: 01/31/2025
Status: Active
URL: https://rip.trb.org/View/2006836

Development of Guidelines for Compatible Sensor Installation, Data Collection, and Database-based Visualization for INDOT

This project will develop comprehensive guidelines and example systems for sensor data collection, integration, and analysis to streamline implementation within INDOT's research division and MIS systems.

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Expected Completion Date: 12/31/2024
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URL: https://rip.trb.org/View/2059482

A Guide for the Development and Use of Truck Traffic Forecasts in Design

Transportation planning and design require different levels of detail with respect to forecasting travel behavior, demand, and use. Whereas many planning decisions can be supported by typical outputs of a four-step travel demand model, these same outputs are insufficiently precise to support many of the decisions being made during detailed project development and design. Truck traffic forecasting is often conducted as a post process of the data results from a travel demand model or is conducted using commodity flow or other economic and statistical models. Yet, a variety of specific decisions regarding the placement, quantity, length, and geometry of facilities to support a specific volume and type of truck traffic would benefit from more specific data, methods, and techniques for using truck traffic forecasts in project design. Among the limitations of typical travel forecasting models are the ability to predict the specific volumes, weights, and

movements of trucks on highways. Truck traffic imposes specific design requirements to accommodate their unique weights and configurations. Transportation agencies and freight distributors need to assess truck travel in different contexts, including but not limited to long-haul goods transportation, local, and last-mile freight deliveries. State departments of transportation (DOTs) and modeling professionals are responding to these challenges by creating more accurate and responsive models and model applications, particularly as the research and development of modeling methods and techniques continue to advance. Nevertheless, the transportation industry is not uniform with respect to its technical knowledge, capabilities, budgets, or other resources needed to develop and apply sophisticated models and decision tools to support project design decision-making. While some state DOTs have the resources to supplement in-house staff or hire outside experts to conduct model runs and analyses, many others simply do not have that capacity. The objective of this research is to develop a guide to assist state DOTs and other agencies in the selection and use of forecasting models, applications, procedures, tools, and techniques needed to support project design.

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Start Date: 01/16/2024
Expected Completion Date: 07/15/2026
Status: Active
URL: https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5131

BIG DATA ANALYTICS

2023 Urban Mobility Report

Overall, 2022 congestion numbers are still lower than 2019, but they are inching up fast. The transportation industry was still witnessing a transition back to a "new normal" in 2022. The trends were different at the regional level, but most areas witnessed a comeback of congestion. Congestion levels in most areas were likely influenced by the level of hybrid work flexibility. It is not yet clear what the lasting effect of the COVID-19 pandemic will be on U.S. urban transportation systems. The mix of strategies that are deployed in urban America will be different for each region — better traffic operations; more travel options; new land development styles; more highways, streets, and public transportation; and advanced technology will all play a role. Working from home, long an underappreciated solution, has assumed a much bigger role in the post-pandemic normal. The trends from 1982 to 2022 show that congestion was a persistently growing problem until 2020, when congestion was different from city to city, road to road, and hour to hour. Post-pandemic America has seen a comeback of traffic congestion, now touching 2019 levels at the individual commuter level, but the nature of congestion and its timing of occurrence have seen a shift too. The congestion estimates of this report are based on traffic speed data from INRIX combined with vehicle and person-volume estimates from the Federal Highway Administration's (FHWA's) Highway Performance Monitoring System (HPMS) dataset.

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Completion Date: 06/2024
Status: Completed
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Vehicle-Based Telemetric Data for State and Local Transportation Agencies

The collection and aggregation of data directly from vehicles has introduced a new set of tools for state and local transportation agencies to fill gaps in their existing understanding of roadway system performance. State and local departments of transportation (DOTs) are heterogeneous, and their needs and uses for telemetric data are nuanced. Telemetric data are defined here as data generated or collected by vehicles and in-vehicle devices. Private sector entities that provide telemetric data and related analytics are still relatively new and may be reluctant to share their data. Advancing technologies are changing the landscape relative to an agency's ability to improve safety, operations, and other DOT business practices. However, new technological capabilities uncover challenges related to telemetric data availability, accessibility, integration, privacy, and use. The research objectives are to (1) determine what telemetric data is available to state and local DOTs; (2) determine how telemetric data is being used by state and local DOTs; and (3) identify challenges and opportunities for the use of telemetric data.

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Start Date: 20240322
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URL: https://rip.trb.org/View/1892169

Improving Travel Time Data Integration and Estimations for Strategic Prioritization

The primary goal of this research is to identify options for improving travel time savings values produced by North Carolina Department of Transportation (NCDOT) for highway projects in the STIP context. The feasibility of increasing the accuracy and consistency of travel time savings will be explored. By leveraging the strengths of microsimulation and aligning it with statewide models, the accuracy and application of travel time data for highway projects in the STIP can potentially be improved, leading to more informed project prioritization and resource allocation decisions. In order to develop the most informed options for NCDOT, the current related practices at NCDOT and other modern approaches for producing and integrating travel time data sources used by other DOTs will be reviewed. This information will guide analyses conducted to identify options for improving travel time savings. This iterative process will involve experimentation with different alternatives, testing these alternatives using project data submitted through the prioritization process, and presenting results to key stakeholders whose feedback will be incorporated into each iteration of analysis. By understanding the differences in data granularity, accuracy, and applicability, the research team can work toward aligning the two data sources to enhance the accuracy and consistency of travel time savings values within the STIP context. Documentation will be delivered at every phase of this project to provide NCDOT with resources that can be used immediately and into the future. Key results of this work will be documented in a white paper NCDOT can use to communicate the current state of the practice related to travel time data and analysis at NCDOT and nationally. Presentations that outline incremental project progress and are suitable for sharing with the Prioritization Workgroup, a white paper outlining options for improving travel time savings, a technical guide detailing any recommended methodological changes, and a final report will be developed. Every research activity will be conducted with a focus on helping NCDOT achieve the goal of improving travel time savings estimations in an evidence-based way.

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Further Refinement and Integrated Platform for INDOT Traffic Management and Safety Toolset

This project addresses INDOT's need to use highway surveillance cameras to gather traffic information, such as flow rate, weaving data, and traffic anomaly detection. TASI and INDOT will work on two objectives: (1) the expansion and refinement of the anomaly detection method being developed, (2) the development of a user-friendly system that integrates the software developed for lane-based flowrate detection, weaving analysis, and anomaly detection in the past and present, and other TASI and INDOT jointly developed traffic management tools in the near future. The final system will be deployed to INDOT for daily operations.

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Status: Active
URL: https://trid.trb.org/View/2401904

Effect of Centerlines on Prevailing Traffic Speeds on Low-Speed, Two-Lane, Two-Way Roads in Urban Contexts

The Minnesota Manual on Uniform Traffic Control Devices (MUTCD) requires that centerlines be placed on paved urban arterials and collectors with traveled ways of 20 feet or more and greater than 6,000 vehicles per day (vpd) and recommends their use (i.e., "should" condition) when volumes exceed 4,000 vpd. However, centerlines are not required on urban streets if the Average Daily Traffic (ADT) is below 4,000 vpd, and there is little additional guidance regarding the conditions for their use in such contexts. The principal objective of this proposed research is to determine the relationship between centerline presence and prevailing traffic speeds on low-speed, two-lane, two-way urban streets in Minnesota. This objective will be accomplished through a series of field studies to examine the variation in driver speed selection behavior due to the presence and absence of centerlines, while controlling for the effects of other influential roadway features such as width of the traveled way, surrounding land use context, non-motorized facilities or activity level, and other factors. The results will provide critical guidance to Minnesota Department of Transportation (MnDOT) and local agencies concerning the utilization of centerlines on low-speed, two-lane, two-way roads in urban areas to accommodate the needs of all users.

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Start Date: 20240722
Expected Completion Date: 20260630
Status: Active
URL: https://trid.trb.org/View/2406777

Designing for Target Speed

The American Association of State Highway and Transportation Officials (AASHTO) defines design speed as "a selected speed used to determine the various geometric features of the roadway. The assumed design speed should be a logical one with respect to the topography, anticipated operating speed, the adjacent land use, and the functional classification of the highway." The working definition for "target speed" is the operating speed that the designer intends for drivers to use. The topic of "design speed" versus "target speed" typically focuses on low-speed urban and suburban roadways, especially where the 85th percentile speed is higher than the posted speed limit. Research is needed to gain a better understanding of how roadway, roadside, and non-roadway elements influence the operating speed—the actual speed of the driver—in order to improve roadway designs and reliably achieve desired speed outcomes. The objectives of this research are to (1)

determine the effects of roadway, roadside, and non-roadway elements on operating speeds on roadways with a target speed between 30 and 40 mph and (2) develop recommendations on how the findings can be incorporated into the roadway design process.

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Connected Vehicle Trajectory Data to Screen Network for Hard Braking and Hard Acceleration Events

Hard Braking data has been demonstrated as an important emerging data source that provides quicker feedback than crash data. There is now an opportunity to further apply hard braking/acceleration event data to identify and prioritize intersections (Signals, roundabouts, four way stops) for further safety study. This study will expand develop procedures for non-interstate routes to systematically screen all intersections (signals, roundabouts, stop controlled) on a monthly basis. Additional data sources, such as lane departure warning will also be evaluated.

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Analyzing and Predicting Truck Travel Time Reliability

Truck travel time reliability (TTTR) is one of the most important performance measures for assessing freight movement on the interstates. The Virginia Department of Transportation (VDOT) and the Office of Intermodal Planning and Investment (OIPI) have been reporting TTTR as required by the FHWA and using TTTR in various project planning and performance measurement processes. They are interested in data-driven approaches to identify the locations and causes of unreliable truck travel times and to predict TTTR metrics. This study will address the research needs by developing a systematic method to identify the location, time period, and causes of unreliable truck travel times, and develop models to predict TTTR.

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Modeling Travel Time Reliability for Non-Interstate National Highway System Routes

Travel time reliability measures are increasingly used in system planning and performance measurement processes at the Virginia Department of Transportation (VDOT) and the Office of Intermodal Planning and Investment (OIPI), so predicting travel time reliability measures and setting realistic performance targets have become critical. VDOT and the OIPI have conducted several studies on travel time reliability of interstate highways, but the reliability on non-interstate highways is not well studied. A data-driven target setting process

based on current and future conditions would help not only generate realistic targets, but also track progress over time. This project aims to analyze travel time reliability on non-interstate National Highway System (NHS) arterials by (1) understanding factors that affect travel time reliability performance and the level of their impacts, (2) developing methods to estimate travel time reliability at a planning level, and (3) evaluating impacts of improvement projects on travel time reliability. Arterial-specific roadway attributes, such as traffic signals, will be the focus of the exploration. Results of this study will help VDOT and OIPI to better understand arterial travel time reliability measure and the underlying influencing factors, which will be the foundation to improving arterial travel time reliability and achieving quantitative reliability-based decision making.

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Automatic Signal Retiming for Large Scale Networks with Vehicle Trajectory Data

Traffic signal optimization is known to be a cost-effective method for reducing congestion and energy consumption in urban areas without changing physical road infrastructure. However, due to the high installation and maintenance costs of detection systems, most intersections in practice are controlled by fixed-time traffic signals that rely on manual data collection and are not regularly optimized. Readily available vehicle trajectory data offers unprecedented opportunities for a more efficient use of existing infrastructure and resources. The recently developed OSaaS (Optimizing Signals as a Service) system uses vehicle trajectory data as the only input to optimize traffic signals. OSaaS allows us to easily monitor traffic performance, diagnose signal timing issues, and optimize signal timing parameters. However, to put OSaaS into practice, an automated process needs to be developed so that manual effort can be minimized. For example, traffic flow parameters such as saturation flow rate and free-flow speed can be calibrated automatically by using historical vehicle trajectory data. Therefore, the project will further develop OSaaS into a data-driven automatic signal retiming system that will update signal timing parameters for fixed-time and coordinated-actuated signalized intersections on an iterative basis (i.e., bi-weekly, monthly).

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Leveraging Probe-Based Data to Enhance Long-Term Planning Models

ng-range transportation planning (LRTP) and travel demand models (TDMs) play an important role in the planning process, which assists transportation agencies with prioritizing future transportation investments. Improved LRTP and TDMs can bring direct benefits to transportation planning in the state. Effective transportation planning and investment decision making depends on timely, comprehensive, and accurate data. However, traditional data collection methods only provide a "snapshot" of the travel information, which limits the performance of conventional LRTP and TDMs. In this regard, while these sources are still used, transportation planners at the state, metropolitan, and local levels are beginning to incorporate third-party

traffic data into their planning processes. Planners also start to look at the opportunities afforded through third-party data and provide guidance on how to take advantage of that data to expand and improve planning practices. This project aims to utilize probe-based data to improve the LRTP process and TDMs used by TxDOT, MPOs and other planning agencies in the state. The research teams will study how probe-based and location-based data may be leveraged to facilitate the validation and calibration of existing planning models, enhance existing modeling tools, and incorporate advanced modeling techniques.

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Connected Vehicle Trajectory Data to Screen Network for Hard Braking and Hard Acceleration Events

Hard Braking data has been demonstrated as an important emerging data source that provides quicker feedback than crash data. There is now an opportunity to further apply hard braking/acceleration event data to identify and prioritize intersections (Signals, roundabouts, four way stops) for further safety study. This study will expand develop procedures for non-interstate routes to systematically screen all intersections (signals, roundabouts, stop controlled) on a monthly basis. Additional data sources, such as lane departure warning will also be evaluated.

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Expanding Connected Vehicle Data Framework (CVDF) Data Sources to Increase Applications and Use on Texas Roadways

Connected vehicle (CV) technology is enabling transportation systems to become safer and smarter. Texas is assembling a robust CV ecosystem, with several CV deployments underway. At the heart is the Connected Vehicle Data Framework (CVDF), a data exchange that enables Texas Department of Transportation (TxDOT) to publish key information, such as work zone locations and travel times, as well as ingest data from other public agencies and third parties regarding traffic characteristics, road weather conditions, and safety events. Constraints in data access and format standardization, however, limit the CVDF from realizing its full potential. This project will leverage the existing CVDF that currently supports the Texas Connected Freight Corridors project to expand its efficacy through applications, data partners, and corridors. By expanding the CVDF, TxDOT will unlock new benefits—improved real-time traveler information; increased CV adoption in passenger and freight markets; and more strategic infrastructure investments. This project will deliver a CVDF Expansion Toolkit that includes: (1) New applications that improve safety and mobility (e.g., truck parking availability, road weather warning, border wait times); (2) Recommended data partners from local and regional agencies as well as third-party data providers to improve traffic operations; and (3) Corridor investment strategies that identify Texas roadways for CV operations and describe infrastructure readiness tactics.

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Vehicle-Based Telemetric Data for State and Local Transportation Agencies

The collection and aggregation of data directly from vehicles has introduced a new set of tools for state and local transportation agencies to fill gaps in their existing understanding of roadway system performance. State and local departments of transportation (DOTs) are heterogeneous, and their needs and uses for telemetric data are nuanced. Telemetric data are defined here as data generated or collected by vehicles and in-vehicle devices. Private sector entities that provide telemetric data and related analytics are still relatively new and may be reluctant to share their data. Advancing technologies are changing the landscape relative to an agency's ability to improve safety, operations, and other DOT business practices. However, new technological capabilities uncover challenges related to telemetric data availability, accessibility, integration, privacy, and use. The research objectives are to (1) determine what telemetric data is available to state and local DOTs; (2) determine how telemetric data is being used by state and local DOTs; and (3) identify challenges and opportunities for the use of telemetric data.

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Guide to the Application of Spatial Segmentation on Travel Time Reliability Measures

Travel time reliability measures create a consistent means of comparing the performance of different highways in the network. Travel time reliability measures inform decisions regarding highway capital and operating investments and facilitate accurate public reporting of highway travel times and performance. Additionally, travel time reliability is a required federal performance measure for state departments of transportation (DOTs) and large metropolitan planning organizations (MPOs). Travel time reliability measures are affected by the way highway corridors are divided into segments for data collection, analysis, and reporting. Corridors with fewer segments may "average out" the impacts of congestion "hot spots" along a corridor, creating less reliability in practice. Shorter and more intentionally defined road segments may have the effect of creating more predictable and consistent reliability measures by isolating the impacts of places that experience more or less episodes of congestion. However, the travel time reliability measures calculated for longer corridors with many "hot spots" can be less certain and comparisons of reliability measures calculated for roads within a network cannot always be trusted. Typically agencies obtain travel time and speed data from third-party probe data suppliers who use predetermined segments. To improve travel time reliability measures, practices, and reporting, transportation practitioners need direction on the application of methods for supplementing these data using segmentation and aggregation to produce the most consistently reliable measures, ones that can be compared across the network and used for public communication and investment decision-making. The objective of this research is to develop a guide for designing, modeling, and applying roadway segmentation in travel time reliability measurement to generate improved reliable predictions across similar roadway contexts.

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Status: Active
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Expanding Connected Vehicle Data Framework (CVDF) Data Sources to Increase Applications and Use on Texas Roadways

Connected vehicle (CV) technology is enabling transportation systems to become safer and smarter. Texas is assembling a robust CV ecosystem, with several CV deployments underway. At the heart is the Connected Vehicle Data Framework (CVDF), a data exchange that enables Texas Department of Transportation (TxDOT) to publish key information, such as work zone locations and travel times, as well as ingest data from other public agencies and third parties regarding traffic characteristics, road weather conditions, and safety events. Constraints in data access and format standardization, however, limit the CVDF from realizing its full potential. This project will leverage the existing CVDF that currently supports the Texas Connected Freight Corridors project to expand its efficacy through applications, data partners, and corridors. By expanding the CVDF, TxDOT will unlock new benefits—improved real-time traveler information; increased CV adoption in passenger and freight markets; and more strategic infrastructure investments. This project will deliver a CVDF Expansion Toolkit that includes: (1) New applications that improve safety and mobility (e.g., truck parking availability, road weather warning, border wait times); (2) Recommended data partners from local and regional agencies as well as third-party data providers to improve traffic operations; and (3) Corridor investment strategies that identify Texas roadways for CV operations and describe infrastructure readiness tactics.

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Analysis and Assessment of the National Performance Management Data

Moving Ahead for Progress in the 21st Century Act (MAP-21) and Fixing America's Surface Transportation Act (FAST Act) laid the groundwork for a comprehensive national-level performance management framework. The first 4 year reporting period began January 1, 2018, and ended December 31, 2021, and is the first complete set of consistent national-level performance management data. The availability of this data is an opportunity to conduct the first comprehensive analysis and assessment of this unique data set. Research is necessary to: (1) understand the metrics and perform sensitivity analyses for the 17 transportation performance measures (TPM) for the three performance areas; (2) document processes being used to establish performance targets and how these influence performance outcomes; (3) assess the degree to which the performance analysis is influencing project planning and programming; (4) identify potential revisions to existing performance measures, identify gaps in measures, and develop mechanisms that could address these gaps that would help to set and achieve meaningful outcomes; and (5) explain the results of the national performance data analysis in a way that can be used to effectively communicate the current performance of the highway transportation system. The objective of this research is to develop and implement a framework to analyze and assess the national performance management data from MAP 21 and the FAST Act to present a more complete performance story of the highway transportation system.

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A Deep Learning-based Network-wide Traffic Prediction Model for Integrated Corridor Management Systems

The objectives for this study are as follows: (1) Develop a deep learning-based modeling framework for high-fidelity traffic prediction utilizing traffic sensors, link capacity, socio-economic, and land use data; (2) Develop a predictive strategy evaluator to assess the impact of potential traffic management strategy given an incident and predicted traffic; (3) Develop a data pipeline that can feed a range of datasets and deliver prediction outputs to a visualization application; and (4) Create a data visualization dashboard providing traffic flow information (such as volume and travel time by link) to show future traffic forecast.

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URL: https://rip.trb.org/View/2194299

Cost-effective Traffic and Roadway Data Collection Using Edge-based Comprehensive Sensing System: A Machine Learning Based Approach

The primary goal of this research is to develop a robust and cost-effective traffic-sensing and data-processing system including software algorithms and a hardware unit to address the current unequal and insufficient collection of traffic data. The software system must be compatible with the Washington State Department of Transportation (WSDOT) system and connected with the existing TMC equipment seamlessly. Moreover, the hardware system should be easy to install and maintain as well as a competitive cost. To achieve this goal, the research objective includes the following aspects: (1) Propose a machine learning (ML)-based approach for realizing cost-effective traffic and roadway data collection. ML technology has the capability to effectively learn and extract knowledge from large amounts of data. Specifically, deep-learning-based object detection, localization, classification, tracking, and counting will be utilized in this project due to its outstanding capability to learn deep representative features with high accuracy and efficiency. (2) Incorporate the algorithm in an edge-based comprehensive sensing system MUST. This means the whole data process will be finished on edge devices without the need to transfer data back to a server. One existing problem here is deploying the model efficiently on edge devices while considering computational restrictions. Also, the system should function well in locations with poor communication infrastructure or safety concerns due to geometry and volume constraints. (3) Collect and categorize important traffic information accurately and automatically. This information includes classified vehicle volumes (FHWA 13-bin classification), road surface conditions, visibility, and other relevant data. It is important to note that this system only focuses on the data collection of vehicles, not including pedestrians or cyclists. To sum up, the expected outcomes of this project are a traffic data sensing and processing system deployed in a mobile unit. This system should be capable to perform a 13-category vehicle classification and help researchers collect information where traditional methods cannot be used for safety or functional limitations. The collected traffic data will support data-driven decision making and more advanced technology development in related fields.

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Expected Completion Date: 08/31/2025
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Generating Reliable Freight Disruption Measures with Freight Telematics Data

Disasters on the transportation network raise awareness of the need to plan for quick mobility and recovery whether they are due to human error, human intent, or nature. Therefore, understanding how resilient a network is to such events provides opportunities for transportation agencies to better prepare. Resilience measures then become a useful tool to evaluate and predict impacts of disruptions and recovery to guide investment decisions to protect against these events. When it comes to freight network system measurements there are two major challenges the states and other agencies face: (1) the absence of data and (2) the lack of methods of analysis. There are robust data for the movement of people and passenger vehicles but understanding the way freight moves presents different types of challenges to decision-makers especially under disruptions scenarios. These movements are based upon supply chain decisions made by individual corporations, which quite often change over time due to various economic conditions. Freight often moves across numerous jurisdictions and by multiple modes of transport (e.g., air, rail, water/marine, and truck). Data that captures origins and destinations, as well as methodologies of collecting and utilizing data across multiple jurisdictions and modes, are extremely limited for freight. Currently, decision-makers are only able to use a few data sources that help in identifying freight movements among States and regions, commodities, tonnage, and value. With this in mind, this research presents a framework based on telematics technology from EROAD, a regulatory telematics technology company from New Zealand who has provided telematics services to over 69,000 vehicles (and already collected data), to evaluate this data source for generating reliable freight network resiliency measures. EROAD is a company that develops and implements technology to modernize traditional paper-based systems within the trucking industry. As part of this modernization, EROAD collects the data used for generating reliable freight performance measures. Still, EROAD data has yet to be used for such an application. This research utilizes the Pacific Northwest as a case study which will allow the research team to evaluate freight movements over various jurisdictions (e.g., within state and state-to-state) and assess EROAD data in the development of reliable freight network resiliency measures. Given that EROAD data captures freight telematic data for truck movements, this study focuses on the trucking mode. The findings of this study have the potential to generate new and reliable freight network resiliency measures utilizing a new source of data for state transportation planners.

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Free Flow Speed Estimation Methodology for Performance Measures

Free flow speed (FFS) is used as an input for many key performance measures, such as travel time reliability and congestion measures for interstates and arterials. While traffic practitioners generally agree on the idea that FFS should be estimated under good weather conditions and without incidents, some studies suggest that driver behavior is always in a compromised status under the influence of both internal and external conditions. FFS calculated using different methods can yield varied, inconsistent results. In response to VDOT operational needs, it is imperative to develop consistent free flow speed estimation methods for performance measures. In response, this project will develop a set of methodologies to (1) compare commonly available FFS estimation methods on interstates, (2) evaluate how FFS estimates affect performance measurements on the interstate network, and (3) explore the usage of probe data for arterial FFS estimation.

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Start Date: 12/01/2022
Expected Completion Date: 11/30/2024
Status: Active
URL: https://trid.trb.org/View/2077947

Leveraging Probe Data for Improving Incident Management Practice in Rural Areas

This proposed study aims to (1) acquire applicable probe data from applicable providers, and (2) spatially match the probe data to the OTD traffic count locations in the rural areas of Georgia for data fusion, (3) conduct a case study for a high-risk rural area in Georgia to showcase the feasibility of using the pooled data for improved incident management through predictive incident modeling.

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Best Practices for Data Fusion of Probe and Point Detector Data

Data fusion is the process of integrating multiple data sources to produce more consistent, accurate, and comprehensive information than that provided by any individual data source. In a transportation context, transportation agencies are seeking to define the types and characteristics of data for entry into data fusion engines. Research is needed to identify the challenges, issues, and proven or potential practices for performing data fusion to measure or forecast travel time, speed, reliability, and other aspects of operational performance on roadway networks. Traffic datasets of interest include point sensors; Bluetooth; data from GPS devices embedded in smartphones, personal navigation devices, taxis, and fleets; third-party travel time data; and emerging connected vehicle (CV) data sets. Research that enables better knowledge of the network state could help improve traffic management and planning decisions to address impacts of recurrent and non-recurrent (e.g., incident-related) congestion. Improved network state estimates could also enhance safety outcomes by identifying locations with high crash rates and anomalous traffic flow conditions. The objectives of this research are to do as follows: (1) Develop a process to (a) identify specific objectives for data fusion; (b) identify data sources available for fusion; (c) select the most suitable data for fusion; and (d) facilitate the fusion itself. (2) Develop guidelines for transportation agencies to facilitate data fusion, improve data reporting, and ultimately improve traffic management.

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Start Date: 09/07/2022
Expected Completion Date: 03/07/2024
Status: Active
URL: https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5135

Development of an Intelligent Traffic Monitoring System Based on Artificial Intelligence

Tennessee Department of Transportation (TDOT) provides essential services to support transportation operations on Tennessee highways. Among these services is the critical incident management service, one of the Transportation Management and Operations (TSM&O) strategies that significantly impact traffic flow in

Tennessee. Coordinated action between all four regions managed through the various TDOT Traffic Management Centers requires better insights and analysis of the performance and operational awareness of the interstate highways and the surrounding roadways. The major challenge with the lack of information and real-time insights is the delayed detection of incidents and the inability to manage the response successfully and on time. The question that faces the team and TDOT is the following: can we use advanced sensor fusion techniques to obtain reliable insights from a collection of heterogenous sensors and achieve similar insights that may be gathered through expensive but high-resolution camera arrays.

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Using Vehicle Probe Data to Evaluate Speed Limits on Texas Highways

Texas Department of Transportation's (TxDOT's) current practice is to conduct numerous speed studies throughout the year to determine if the speed limits should be changed due to new traffic patterns, development, crash history, and other factors. These studies are driven by stakeholder requests or as part of routine annual reviews. The number of studies performed at any given time is limited by staff and consultant resources, resulting in a process that can take several months to complete. Can the increasing availability of vehicle probe data, along with other big datasets, be used to reduce the level of effort and time needed to collect speed data? If so, what data can be readily obtained from big data sources and what procedure would be needed to refine the use of probe speed information and produce speed limit recommendations that are consistent with the sound engineering practices currently used by TxDOT staff? This project will explore if there are more efficient methods for conducting Texas speed limit studies that would allow TxDOT districts to be more pro-active and responsive with their speed zone program. Such a program would also provide a much safer method of collecting speed data, especially on high-speed and controlled access highways.

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Research on Artificial-Intelligence for Data Integration with State Highway

Active traffic management implies the dynamic management of recurrent and non-recurrent congestion based on current and predicted traffic conditions. The goal of this project is to improve mobility and safety using data analytics and artificial intelligence applied in active traffic management for arterial freeway interactions. The project team will develop an integrated system that uses data collected from videos and loop detectors and other sensors for this purpose. Using machine learning and artificial intelligence, the team will develop techniques that will support real-time traffic management.

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TITANv2 – Interactive, Web-Based Platform for Transportation Data Integration, Visualization and Predictive Analytics

The rate of transportation data collection is poised to increase exponentially with mobile computing, community-based sensing and vehicle-to-vehicle and vehicle-to-infrastructure communications. Under TR2018015 the research team designed a prototype interactive, web-based platform to assist decision makers at Missouri Department of Transportation (MoDOT) by seamlessly integrating and analyzing transportation datasets. This phase 2 project will create a robust web platform that pulls together data from TMS and other sources to provide dashboards which help make sense of various data sets. The platforms are interactive and can provide real time information or longer duration information. This platform will also help the TMCs with real time travel information and performance measures.

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Expected Completion Date: 12/31/2024
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Synthesis of Information Related to Highway Practices. Topic 55-02. Practices for Collecting, Managing, and Using Light Detection and Ranging (LiDAR) Data

While collection and use of LiDAR data has become widespread, state departments of transportation (DOTs) often have questions on ways to improve their own processes, especially as advances in data governance practices, analysis methods and tools, technologies related to all aspects of state DOT activities, and other areas expand the potential benefits and challenges with using LiDAR data. NCHRP Report 748, Guidelines for the Use of Mobile LiDAR in Transportation Applications, assisted with developing comprehensive LiDAR programs. Since its publication in 2013, LiDAR technology has improved and state DOTs' experiences with LiDAR have grown, and documentation of existing practices, business use, and needs would benefit state DOTs' efforts. The objective of this synthesis is to document state DOTs' practices related to technical, administrative, policy, and other aspects of collecting, managing, and using LiDAR data to support state DOTs' current and future practices.

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Start Date: 12/02/2024
Expected Completion Date:
Status: Active
URL: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5469

WEIGH-IN-MOTION

Weight-In-Motion (WIM) Analysis for New Jersey Bridges for Establishing Various Live Load Models for Design and Bridges Management Task

The goal of the study is to analyze NJ's recorded weigh-in-motion (WIM) data for establishing various live load models for the design and evaluation of bridges. In addition, the objective is to calibrate the load factors based on the latest edition of the "Manual of Bridge Evaluation (MBE)" for Specialized Hauling Vehicles (SHVs) to avoid (if possible) load posting of bridges. The main tool to analyze the live load effect on bridges is utilizing reliable WIM data. Although there is a gigantic, collected WIM database for New Jersey, there is a need for a reliability-based analysis to update and improve the live load models for bridges in the state of New Jersey as follows: • Permit trucks with various axle configurations will be identified using WIM data analysis. This will provide an opportunity for NJDOT to add additional live load models (i.e., live load models exceeding the gross weight of more than 80,000) for load rating and evaluate its process for issuing or granting annual permits. • Validate NJ's existing LRFD permit load model (i.e., 8-axle & 200 kips) and make necessary changes if needed. Different live load factors would be established for both new bridges and existing bridges. • Analyze NJ's existing steel bridge data (e.g., Rolled steel I girder with E and E' fatigue category) to identify the risk of load-induced fatigue cracking. • Analyze NJ's existing steel bridge data (e.g., welded plate girder with skew angle equal to or greater than 30 degrees with staggered cross frames/diaphragms) to identify the risk of distortion-induced fatigue cracking. • Validate NJ's existing load factor of 1.30 for operating rating of SHVs to avoid (if possible) load posting of bridges.

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Start Date: 20240506
Expected Completion Date: 20270506
Status: Active
URL: https://trid.trb.org/View/2410355

Multiple-Sensor Weigh-In-Motion Systems to Enhance Data Accuracy and Reliability

Weigh-in-motion (WIM) systems measure the axle weight of moving vehicles as they traverse WIM measurement sites. WIM data are essential for the design, assessment, and maintenance activities related to pavement and bridge infrastructure and may be used for monitoring and enforcing motor carrier truck weights and dimensions and collecting tolls. WIM sensors vary from instrumented metal plates to piezoelectric, quartz, and strain gauge strip sensors. Their accuracy is evaluated with reference to static loads referenced in the American Society for Testing and Materials, Standard Specification for Highway Weigh-In-Motion (WIM) Systems with User Requirements and Test Methods, ASTM E1318-09 (2017) and is affected by the interaction between roadway roughness, vehicle dynamics, and speed. The narrow strip-type WIM sensors that sample a smaller part of the dynamic axle loads applied to the road may be strategically spaced to capture more data points of the dynamic axle load waveforms by using multiple strip sensors (two or more). The use of multiple strip sensors will potentially result in increased data reliability and more accurate estimates of the corresponding static axle loads, reduce measurement error, improve data quality, and reduce maintenance costs. State departments of transportation (DOTs) require accurate and cost-effective WIM technology. Research is needed to assess and optimize multiple-sensor spacing and determine its benefits and feasibility. The objective of this project is to develop a model to determine the optimal number of WIM strip sensors and array layout, given specified levels of accuracy and reliability considering pavement, environmental, and traffic conditions.

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Status: Active

URL: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5509

Estimation of the Load Rating of Existing Highway Bridges Based on Bridge Weigh-in-Motion Data

To ensure safety and uninterrupted functionality, bridges are evaluated for live load capacity, including their reserve capacity for future live loads, which informs important maintenance decisions by state agencies. Previous studies have shown that conventional analytical load ratings without bridge-specific information can often result in overly conservative load capacity ratings, resulting in unnecessary load limitation and posting and remedial actions. As such, objective and data-driven knowledge of actual site-specific loads can result in more accurate load ratings and sizeable cost savings. Bridge Weigh-in-Motion (B-WIM) technology is a low-cost, practical solution to transform a bridge into a scale to characterize traffic loads. B-WIMs can use monitoring data collected from nondestructively instrumented bridges to obtain vehicle loading, speed, and type, as well as axle weights and spacings. This project aims to develop methods and processes for establishing a B-WIM program for the Illinois Department of Transportation and utilizing the data from B-WIM for load capacity ratings. Researchers will aim to come up with a system design that can deliver an accuracy within a tolerance range of ±5% with a confidence level of 95% across the majority of outcomes. The project will provide Illinois Department of Transportation (IDOT) with a comprehensive review of the best practices, a methodology to design and deploy B-WIM systems for Illinois bridges, and a load rating procedure that leverages B-WIM survey data for objective data-driven load rating of IDOT bridges.

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Start Date: 20240816
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Investigation of Heavier-than-Expected Vehicle Weights Observed in the Vicinity of the Savannah Port Area and their Impact on Georgia's Pavements and Bridges and Rate of Statewide Asset Degradation

The primary objective of Part A of this project is to investigate the impact of heavy vehicle traffic on pavement and bridge structures in Georgia. The main objective of Part B of this project is to evaluate pavement and bridge structures using weigh in motion (WIM) data, conduct field investigations, and evaluate the reliability of existing pavement and bridge structures.

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Start Date: 09/30/2023
Expected Completion Date: 09/30/2026
Status: Active
URL: https://rip.trb.org/View/2265649

Impact of WIM-based Direct Enforcement on the Service Life of Bridges

The Brooklyn-Queens Expressway (BQE) in New York City is a crucial corridor connecting the two boroughs of Brooklyn and Queens with other counties. Given its substantial daily traffic for transporting goods and services, the longevity of BQE is crucial to enhance public safety and alleviate congestion. The team has collaborated with the New York City Department of Transportation (NYCDOT) to implement (1) an integrated weigh-in-motion (WIM) systems on the northern part of the BQE corridor for a direct

enforcement of the high percentage of overweight (OW) trucks, and (2) a structural health monitoring (SHM) system to estimate the remaining service life of the BQE structures. This project synthesizes WIM and SHM data to study the impact of the reduction in OW percentage over time resulting from direct OW enforcement on extending the service life of the BQE. Furthermore, the team will conduct a life-cycle cost analysis (LCCA) of the network of bridges in NYC based on the established correlation. The output of this project will be a new framework to evaluate the effect of reduced OW percentage on the service life prediction. This framework will help introduce new legislation(s) for direct OW enforcement to mitigate the number of OW trucks and their OW tonnages; thus, improving bridge service life and preserving highway infrastructure. Another aspect of this proposal is to expand the potential uses of physical testbeds to investigate the feasibility of utilizing biometric sensors, including eye tracking glasses, galvanic skin response sensors, and heart rate trackers, to assess the perceived safety of micro-mobility users, encompassing both cyclists and e-scooter riders. The primary objective is to collect pilot data to develop well-structured semi-naturalistic experiment protocols, allowing for the acquisition of reliable psychological data concerning the safety perceptions of micromobility users. The acquired sensor data will be cross-referenced with qualitative survey responses to analyze the advantages and disadvantages of various methods for collecting safety perception data among micromobility users. The data collected from these experiments will play a crucial role in providing insights into the types of infrastructure designs that are well-received by micromobility users and identifying built environments considered unsafe for travel. These findings will be invaluable for informing infrastructure design improvements aimed at enhancing the travel experiences of micromobility users, supporting mode shifts, and mitigating congestion.

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Status: Active
URL:
https://c2smarter.engineering.nyu.edu/impact-of-wimbased-direct-enforcement-on-the-service-life-of-bridges

PEDESTRIAN AND BICYCLES

Implementation of Accessible Temporary and Alternate Pedestrian Access Routes in the Public Right-of-Way

Research on temporary and accessible alternate pedestrian access routes for people with disabilities is limited, with a primary focus on people with vision impairments. Qualitative studies highlight that inaccessible routes disproportionately impact people with disabilities. National guidance is minimal, largely limited to standards from the Manual on Uniform Traffic Control Devices (MUTCD) and the Public Rights-of-Way Accessibility Guidelines (PROWAG). State and local guidance on temporary traffic controls varies significantly; while some states adhere strictly to national guidelines, others have developed more comprehensive protocols. Challenges in achieving accessibility compliance under existing guidance remain inadequately addressed with current research. Without defined parameters or sufficient engagement with people with disabilities, implementation often relies heavily on engineering judgment. Furthermore, common and emerging design solutions offer limited evaluation for accessibility and user experience, leading to inconsistency and uncertainty among practitioners. Research is needed to create user-centered accessible design for temporary and alternate pedestrian routes, ensuring safe and effective mobility for people with disabilities. OBJECTIVE: The objective of this project is to develop a guide for state and local transportation agencies, contractors, and permittees on implementing temporary and accessible alternate pedestrian access routes in public

rights-of-way in a variety of design and land use contexts, considering the diverse needs of pedestrians with disabilities (e.g., mobility, visual and hearing impairments, intellectual/developmental).

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Expected Completion Date:
Status: Active
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Synthesis of Information Related to Highway Practices. Topic 56-05. Traffic Analysis Practices for Non-Motorized Modes (Vulnerable Road Users)

Traffic analysis, whether for operational, design, or planning purposes, plays a crucial role in informed decision-making regarding transportation investments. While historically focused on motorized modes and roadway facilities, recent decades have seen advancements in incorporating non-motorized modes into traffic analysis practices. Despite the development of methodologies like the Highway Capacity Manual (HCM) for non-motorized modes, there is limited information on how state DOTs are integrating these modes into their traffic analysis processes. The objective of this synthesis is to document the current state of the traffic analysis practice (not limited to the deterministic methods such as HCM) for non-motorized modes (or multimodal analysis).

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Start Date: 07/01/2023
Expected Completion Date: 06/30/2025
Status: Active
URL: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5716

Evaluation of the Effectiveness of Passive Pedestrian Detection Systems

The objectives of this project are to: Review state of the art of passive pedestrian detection systems (PPDS); Review and document how "near-misses" are defined and measured in the literature; Develop evaluation standards for PPDS; Design test scenarios for evaluation of PPDS; Evaluate field implementation of select PPDS; Provide recommendations to update the Florida Department of Transportation (FDOT) standards and guidelines for agencies and practitioners interested in deploying PPDS.

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Start Date: 11/05/2024
Expected Completion Date: 06/30/2025
Status: Active
URL: https://trid.trb.org/View/2448906

A Framework for Assessing Pedestrian Exposure Using GPS and Accelerometer Walking Data

Quantifying safe pedestrian travel requires a better understanding of the likelihood that a pedestrian will be involved in a potentially harmful pedestrian-vehicle interaction. This is achieved by obtaining a good pedestrian exposure metric, which will let traffic safety experts and policymakers differentiate between

emerging risks and changing patterns of exposure. From this exposure metric, countermeasures can be tailored for different pedestrian walk patterns. The study team first examined pedestrian exposure metrics used in past studies. The team then used data collected from electronic devices from two previous longitudinal studies on walking in the Seattle, Washington, area. Estimates of pedestrian exposure were built on "walking bouts," which are time segments of physical activity during which walking was measured to have occurred. The unit of analysis was at the intersection level. Two models were developed: a zero inflated negative binomial model that examined the likelihood of walking at any intersection in Seattle, and a negative binomial model to examine the frequency of walking at intersections that included at least 10 walking bouts. Explanatory variables included geospatial locations, micro-environmental factors, and macro-environmental factors. This study provides a framework quantifying pedestrian exposure that can be used by other transportation municipalities to capture pedestrian exposure.

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Status: Completed
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Pedestrian Level of Traffic Stress (PLTS) Application and Validation

Many of the existing methods to evaluate pedestrian and bicyclist suitability require a large number of inputs, some of which are not available in typical roadway inventory data (e.g., pavement condition, on-street parking coverage, heavy vehicle proportion), making them impractical for most agencies to apply. Some of these methods also require statistical modeling expertise or specialized software to run, further putting them out of reach for many agencies. Occasionally, their outputs do not make intuitive sense. The Year 1 Center for Pedestrian and Bicyclist Safety (CPBS) project created a well-researched, standardized version of a table-based, Pedestrian Level of Traffic Stress (PLTS) tool. It incorporates many of the most important and easy-to-collect roadway factors associated with pedestrian suitability from a) existing pedestrian suitability methods and b) the pedestrian safety literature. This Year 2 project will build on the previous effort to apply the method in at least two case study communities (including the City of Milwaukee, Wisconsin) and validate the PLTS categories in a sample of locations against real pedestrian stress ratings from public surveys and police-reported pedestrian crash data. The goal is to establish a validated, practical PLTS method that agencies across the country can use to estimate suitability and stress for pedestrians in various contexts, ultimately leading to safer and more enjoyable walking and rolling conditions. As done for the BLTS in 2012, the research team will produce a final technical report that includes a description of the PLTS method. This report will include PLTS tables and example PLTS maps from communities where the method has been tested. The final report will discuss how well the PLTS method works for practitioners and matches with public perceptions of pedestrian stress and pedestrian crash locations. As done for the BLTS in 2012, the research team will produce a final technical report that includes a description of the PLTS method. This report will include PLTS tables and example PLTS maps from communities where the method has been tested. The final report will discuss how well the PLTS method works for practitioners and matches with public perceptions of pedestrian stress and pedestrian crash locations.

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Expected Completion Date: 20250531
Status: Active
URL: https://www.pedbikesafety.org/projects/24uwm05

Mid-Block Pedestrian Crossing Exposure: Count Protocol and Database

Nearly 80% of US pedestrian fatalities occur at mid-block locations, away from intersections. Despite the problem of the most serious pedestrian crashes occurring at mid-block locations, very few transportation researchers and agencies have collected pedestrian crossing counts at these locations. Therefore, the traffic safety profession has almost no understanding of pedestrian exposure at mid-block crossing locations. This prevents researchers and agencies from calculating pedestrian crash rates and therefore understanding which roadway and adjacent land use characteristics may produce the greatest risk at these crucial locations. This pilot project will be conducted in the City of Milwaukee, WI and will explore the following research questions: 1) What are the most effective methods to collect mid-block crossing counts? 2) What roadway, adjacent land use, and other contextual characteristics can be collected efficiently and included in a database of mid-block crossing counts? 3) What characteristics are associated with pedestrian mid-block crossing crash rates? Answering these questions will also help provide the foundation to eventually explore which roadway, adjacent land use, and other contextual characteristics are associated with mid-block pedestrian crossing volumes. This can lead to mid-block pedestrian crossing volume models and predictive models (safety performance functions) for mid-block pedestrian crossing crashes.

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Status: Active
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BikePed Portal: Pedestrian Volume Estimation Based on Push Button Actuations from Signals Data

This project translates research from Oregon DOT's "Active transportation counts from existing on-street signal and detection infrastructure" (SPR 857), into a practical application on BikePed Portal.

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Bicycle Level of Traffic Stress at Intersections

There are two knowledge gaps preventing intersections from being properly accounted for. One is that published criteria for LTS at intersections, which have not changed since LTS criteria were first published in 2012 (Mekuria, Furth, and Nixon, 2012), are meager and only account for the traffic stress involved in pocket bike lanes and multilane, unsignalized crossings. They fail to account for many other factors that may make intersections and crossings a barrier to cycling for many people. The second is that known methods for bike network analysis are based on link-level stress and costs (i.e., distance); their structure is such that they do not recognize stress or cost at nodes. This research will involve the following four tasks: (1) Develop a comprehensive set of criteria for level of traffic stress at intersections. It should account for factors that create stress on an intersection approach (e.g., pocket bike lanes) as well as factors that create stress when passing through an intersection. For the latter, there should be a way to determine level of traffic stress by movement; for example, from a given approach, there might be little or no traffic stress to make a right turn, a moderate traffic stress to go through, and high traffic stress to make a left turn. (2) Develop an algorithm and needed data structures to do network analysis accounting for traffic stress at intersections as well as on links and create open-source code on standard platforms that will allow others to apply these algorithms. (3) Collect data for two cities. One city may be Albuquerque and the other may be a city for which the research team

already has link-level LTS data. (4) Apply LTS criteria for both links and intersections and use the developed algorithms to do connectivity and accessibility analyses. These analyses will serve both to test the newly developed intersection LTS criteria and to test the newly developed network analysis algorithms.

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Status: Active
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Utilizing Traffic Signal Pedestrian Push-Button Data for Pedestrian Planning and Safety Analysis

Transportation planning, traffic monitoring, and traffic safety analysis require detailed information about pedestrian volumes, but such data are usually lacking. Fortunately, recent research has demonstrated the accuracy of pedestrian volumes estimated from push-button data contained within high-resolution traffic signal controller log data. Such data are available continuously for many locations. This project takes advantage of these novel pedestrian traffic signal data to advance pedestrian traffic monitoring and improve pedestrian traffic safety by applying them as estimates of volume and exposure, often alongside advanced machine learning techniques. Through a series of five studies, we identify temporal patterns in pedestrian activity; study the accuracy of pedestrian volume estimation methods over time; use machine learning methods to improve the quality and completeness of pedestrian time-series data; analyze crashes to identify a "safety in numbers" effect for pedestrians; and apply a new deep learning model to better understand factors affecting pedestrian crash severity. Altogether, this work leverages novel pedestrian traffic signal data to further research and efforts in pedestrian traffic monitoring and safety.

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Expected Completion Date: 20240630
Status: Completed
URL: https://www.ugpti.org/resources/reports/details.php?id=1168

Framework and Toolkit for Selecting Pedestrian Crossing Treatments

Methods that agencies currently employ to select pedestrian crossing treatments can vary from one state or jurisdiction to another. In 2006, TCRP Report 112/NCHRP Report 562: Improving Pedestrian Safety at Unsignalized Crossings documented the results of a study of treatments for unsignalized crosswalks and produced (a) recommended pedestrian traffic signal control warrants and (b) guidelines for practitioners to select from treatment categories based on the pedestrian delay. However, the practice has evolved in the last decade, and other factors are often taken into consideration when selecting pedestrian crossing treatments. Quantifiable, objective measures (e.g., pedestrian volume, pedestrian-vehicle crash data) are often used in the determination of treatment type; however, contextual, subjective measures (e.g., latent demand, equity, land use, and pedestrian demographics) are also used, with lack of consistency among the methods used by decision-making entities. Research is needed to (1) help guide agencies in selecting among the treatments levels identified in TCRP Report 112/NCHRP Report 562, including a better understanding of the characteristics of each treatment and how they might be beneficial for a given location as well as consideration of objective and subjective factors in the decision-making process; and (2) develop draft language for consideration in future updates to the Manual on Uniform Traffic Control Devices (MUTCD) and other national-level guidance. The objectives of this research are to (1) develop a framework and toolkit for

selecting pedestrian crossing treatments based on objective and subjective characteristics, and (2) propose new pedestrian warrants and/or guidance.

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Sponsors: National Cooperative Highway Research Program
Start Date: 20240513
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Status: Active
URL: https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5125

Modeling Pedestrian and Bicyclist Crash Exposure with Location-Based Service Data

Actual counts observed at selected locations in short periods of time are extrapolated to generate annual average daily pedestrian and bicyclist traffic estimates. This approach will not adequately display the difference in travel time (e.g., morning, afternoon, or evening), seasonal effects, days of the week, and will not cover the entire street network in a region. One of the main challenges in developing exposure measures is the lack of walking and biking activity data available at a finer spatial resolution, such as street segments, covering the entire road network of a city. The main source of information about area-based exposure measures is survey data (such as ACS or NHTS). The units used in area-based exposure measures vary widely and the geographic scale of available travel data is limiting (only 59 records for Lincoln MSA in the 2017 NHTS). This type of data does not have facility-specific trip information. Some local entities are directly collecting pedestrian and bicyclist count data, but these counts are collected at a very limited number of locations. Therefore, there is a critical need to develop a reliable methodology to analyze pedestrian and bicyclist exposure to risk with emerging data sources.

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Start Date: 07/01/2022
Expected Completion Date: 05/31/2024
Status: Completed
URL: https://rip.trb.org/View/1942732,
https://dot.nebraska.gov/media/tdjdw41b/2024-modeling-pedestrian-and-bicyclist-crash-exposure-with-lbs-data.pdf

State Preference Survey of Pedestrian Street Crossing and Big Data Analysis of Suppressed Pedestrian Trips

The objective of this research is to develop a pedestrian accessibility index that reflects the disutility posed by walking in uncomfortable settings or spending significant time waiting for the opportunity to cross. This index can help the Design Office better understand what designs and conditions result in greater use and attract more individuals to walk versus drive and utilize the designated facilities. This index will then be compared against a review of Replica big data of walking trips and the demographic information of those making those trips and the routes taken. Without this study, FDOT will miss an opportunity to understand which facility design and conditions create the largest benefit in terms of pedestrian use.

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Start Date: 20240613
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Estimating Latent Bicyclist and Pedestrian Demand for Shared Use Path Design

Texas Department of Transportation's (TxDOT's) Roadway Design Manual was updated in July 2020 and incorporates considerations for and accommodations of bicyclists and pedestrians, including preferred design order toward Shared Use Paths (SUPs) compared to bicycle lanes and shared lanes. However, the Guidance does not include specific procedures to estimate the anticipated volumes of non-motorized path users. TxDOT's Bicycle Accommodation Design Guidance makes it clear that anticipated user volumes should be considered when designing facilities. The research team will develop a simple sketch planning-level demand estimation tool that provides anticipated user volumes for SUPs. The project shall also incorporate the results into the future editions of TxDOT's design guidance/manuals. Given the uncertainty in resources, the research team will not use an overly complicated method or a method that requires complex data or data architecture. The project shall benefit from existing data sources, including TxDOT's Texas Bicycle and Pedestrian Count Exchange and other count data resources in the State as well as other secondary and spatial data sources. The research team will develop an easy-to-use tool responding to the needs and requirements of the intended audience while incorporating advancements to improve the accuracy of the demand estimation.

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Mid-Block Pedestrian Crossing Exposure: Count Protocol and Database

Nearly 80% of US pedestrian fatalities occur at mid-block locations, away from intersections. Despite the problem of the most serious pedestrian crashes occurring at mid-block locations, very few transportation researchers and agencies have collected pedestrian crossing counts at these locations. Therefore, the traffic safety profession has almost no understanding of pedestrian exposure at mid-block crossing locations. This prevents researchers and agencies from calculating pedestrian crash rates and therefore understanding which roadway and adjacent land use characteristics may produce the greatest risk at these crucial locations. This pilot project will be conducted in the City of Milwaukee, WI and will explore the following research questions: 1) What are the most effective methods to collect mid-block crossing counts? 2) What roadway, adjacent land use, and other contextual characteristics can be collected efficiently and included in a database of mid-block crossing counts? 3) What characteristics are associated with pedestrian mid-block crossing crash rates? Answering these questions will also help provide the foundation to eventually explore which roadway, adjacent land use, and other contextual characteristics are associated with mid-block pedestrian crossing volumes. This can lead to mid-block pedestrian crossing volume models and predictive models (safety performance functions) for mid-block pedestrian crossing crashes.

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Sponsors: Office of the Assistant Secretary for Research and Technology
Start Date: 20240601
Expected Completion Date: 20250531
Status: Active
URL: https://www.pedbikesafety.org/projects/24uwm04

Statewide Non-Motorized Traffic Monitoring Study

The objectives of this research are to do the following: (1) Consolidate non-motorized traffic data collected by Louisiana Transportation Research Center/Louisiana Department of Transportation and Development (LTRC/DOTD) to date onto a geographic information systems (GIS) platform (2) Explore the possibilities

of consolidating non-motorized traffic data collected by other public agencies onto the same GIS platform. (3) Refine expansion factors for short-term counters with additional data. (4) Evaluate emerging data products by comparing them with counting data collected to date in Louisiana. (5) Evaluate opportunities for and needs pertaining to expanding counting locations to support DOTD's needs..

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Measuring Pedestrian Psycho-Physiological Well-Being in the Built Environment

Current advancements in ubiquitous sensing technologies have the potential to increase transportation designers' understanding of pedestrian behavior and experience. It is now possible to collect human state and behavior data naturalistically and longitudinally. Currently, over 900 million wearable devices are being used worldwide on a daily basis (Tankovska 2020). The application of these devices spans over a variety of fields such as mental health (Coughlin and Stewart 2016), health and physical activity (Kos and Kramberger 2017, Hsu et al. 2018), and sleep monitoring and interventions (Jeon and Kang 2019). Similarly, these technologies can be utilized to identify how pedestrian states, behavior, and well-being vary in different contextual settings. Using mobile sensing technology such as gaze, heart rate, and stress trackers, this research attempts to characterize whether quantitative physiological data (as collected by these sensors) can be used to predict qualitative perception data (captured by stated preference surveys), to ultimately capture changes in the pedestrian urban experience as environmental and infrastructure design variables shift. These user-centric data on road environments are essential for establishing actionable standards linking roadway design to pedestrian well-being. By emphasizing multimodal urban streetscapes that serve as public spaces for people, transportation planners, engineers, designers, and policy makers can reach goals for more livable, safe, and economically vibrant environments.

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Start Date: 09/01/2023
Expected Completion Date: 09/01/2024
Status: Active
URL: https://rip.trb.org/View/2251037

Developing a data fusion framework to map active transportation usage patterns in Orange County

The proposed research aims to create a set of adjustment factors accounting for the built environment, socio-economic, and land-use characteristics which can be applied to crowdsourced data so that policymakers and transportation practitioners across the Southern California region can begin to incorporate exposure estimates more reliably and consistently into their safety, infrastructure planning, and decision-making analysis. The proposed solution will be relatively easy to use and will bring potentially substantial cost and resource savings to communities throughout the country. Public agencies using crowdsourced data can benefit from the proposed methodologies for validating exposure estimates and reproducing methodologies for working with similar datasets. By bridging the gap between crowdsourced data and the resources needed to reliably use that data, these factors will put exposure estimates at the fingertips of communities that urgently need data but have not prioritized it due to resource constraints. This research will also provide insights into bicycling patterns that may be more broadly applicable, such as geographic and sociodemographic variables that consistently impact bicycling volumes in certain contexts or on certain street

types regardless of context. These insights will be useful irrespective of whether a community has crowdsourced data or an established counting program. It will also highlight aspects of disparities in access to safe bicycling amenities that are often not well captured in count programs conducted by local authorities. The underrepresented communities which are often left out of planning decisions will be accounted for in the modeling framework by means of additional data acquired from US Census Bureaus' American Community Survey.

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Expected Completion Date: 06/30/2024
Status: Active
URL:
https://metrans.org/research/developing-a-data-fusion-framework-to-map-active-transportation-usage-patterns-in-orange-county

Integrating Non-Motorist Facility Data into Comprehensive Road Safety Assessment

This project aims to enhance pedestrian and bicyclist safety understanding, bolster educational and professional capacities, and facilitate the practical implementation of computer vision techniques in transportation planning and engineering, ultimately leading to safer transportation systems for pedestrians and cyclists. The project will address challenges in gathering pedestrian facilities data and assessing safety concerns for pedestrians and bicyclists, encompassing a comprehensive process involving literature review, case study design, data collection and preparation, model development and validation, result analysis, and recommendation formulation. Through innovative approaches utilizing satellite images and image processing techniques such as spatial analytics and deep learning models, the project intends to extract crucial information about pedestrian and bicyclist facilities and nighttime streetlight conditions. By leveraging deep neural networks and statistical analysis, the project aims to compare longitudinal datasets, predict injury risks, identify high-risk areas, and unravel potential risk factors and relationships contributing to pedestrian and bicycle accidents, thereby informing evidence-based decisions and interventions. The outcomes of this project will be disseminated through technical reports and academic discussion, contributing to the understanding of non-motorist safety, encouraging further research, and providing educational resources for transportation programs.

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State DOT and Tribal Use of Active Transportation Data: Practices, Sources, Needs, and Gaps

State DOT and tribal active transportation programs and their partners at other state, local, tribal, and territorial organizations are looking to answer questions on data standardization, sharing, and governance such as:

- What innovative, cost-effective data use cases could provide scalable examples among state DOT and tribal practitioners?
- What nontraditional or unusual sources or applications of data (that may be primarily for other purposes) could be adapted or integrated into active transportation analyses (e.g., police and hospital reports)?

- What practices do peer agencies recommend for identifying, collecting, cleaning, utilizing, analyzing, standardizing, storing, publishing, and funding data? How do they address privacy and legal concerns?
- How can tribes and state DOTS exchange data with other tribal, state, and local governments; public transportation; and rural and metropolitan planning organizations (MPOs)?
- What data are available on funding, facilities, public initiatives, multi-use trails, bicycle sharing, micromobility usage, standard practices, staffing, maintenance agreements, regional data-sharing partnerships, and regional and interstate connectivity?
- How many lane-miles of facilities exist or are planned per active transportation mode? How do they relate to funding and funding sources?
- Where, specifically, are resources flowing (geographically)? What also may be behind local agencies not matching project costs by state and federal programs which may prevent active transportation enhancements?
- What resources exist in state DOTs, tribes, MPOs, and local governments? What is the bicycle/pedestrian share of funding and staffing?
- How are tribes and state DOTs staffed to acquire and utilize new data?
- What are examples of effective state DOT and tribal practices in the acquisition, use, maintenance, and application of data? How are they structured? How are they funded?
- How do state DOTs and tribes handle cross-border data practices, including cross-state MPOs, urban/rural overlaps, and tribal/non-tribal jurisdictions?
- What injury data monitoring/surveillance systems are in place? Are there opportunities to further enhance the ability of existing systems to document health and safety outcomes, particularly for active travel modes? What barriers or safeguards are there when it comes to sharing this information with state DOTs and tribes?
- What methods and data sources, if any, are used to measure injuries that are not reported in police crash report systems, including falls and crashes not directly involving vehicles that occur in the right-of-way and could be attributable to the built environment or used for safety and health planning purposes?
- What data is currently not being shared among jurisdictions? Why not?
- What data is currently not being collected? Why not?
- How often are data sets re-collected? Are there best practices to draw on in recommending the frequency of data updates?

Research is needed to summarize existing literature on active transportation data, catalog relevant sources and data sets related to active transportation, identify data needs, and identify data gaps.

The objective of this project is to develop a playbook for state DOTs and tribes on the use of active transportation data. At a minimum, the research team shall: (1) determine how state DOTs and tribes are using data; (2) identify data sources, gaps, and recommendations on the next steps to integrate and develop the data and tools state DOTs and tribes need; (3) assess the state of the practice regarding pedestrian and bicycle injury and death reporting and integration systems; (4) critically examine existing methods; (5) demonstrate best practices; and (6) identify future data improvement needs.

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Exploring the Use of Crowdsourced Data Sources for Pedestrian Count Estimations

Counts provide the foundation for measuring nonmotorized travel along a link or a network and are also useful for monitoring trends, planning new infrastructure, and for conducting safety, health, and economic analyses. For safety analysis, they are critical in assessing the exposure to risk. Over the last decade, several automated technologies have been developed to count bicyclists and pedestrians. Despite advances in counting technology, cost and other considerations will continue to limit direct observation to small subsets of entire networks, as is the case for motorized traffic. A primary limitation with these counters is that they can only provide information about the activity that is directly on or near them but nothing about the activity on the network. The lack of widely available pedestrian count data precludes safety studies and analysis of trends, which has become critically important especially with the nationwide increase in pedestrian crashes over the last decade. The emergence of crowdsourced data such as Strava and StreetLight has allowed for the collection of large-scale datasets over broad areas of the network. While several research studies have evaluated and applied bicycle data from these datasets, no study has yet looked at pedestrian count estimates from these data sources or assessed how these compare to traditional pedestrian counts and other measures of pedestrian activity such as pedestrian actuations from traffic signals. The current study will evaluate pedestrian data estimates from the crowdsourced data sets and explore how these can be used along with traditional count data and sociodemographic data to derive count estimates.

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Evaluation of Gainesville Pedestrian-Bicyclists Connected Vehicle Pilot

This research project will support the University of Florida (UF) AID project through a multifaceted evaluation of the installed hardware and software, as well as pedestrian, bicycle, and skateboarder perceptions, and corridor-level operations.

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Development of Pedestrian and Bicyclist Flow Volumes and Risk Factors

Pedestrian and Bicyclist safety is a growing concern and priority for the U.S. Department of Transportation. Fatalities for non-motorists have increased nationwide since 2009, and this increase has also been observed in Arkansas. The first objective of this project will be to collect data on non-motorized transportation users across the state using count stations and crowdsourced data. Traffic volume data will be overlaid with historical crash data to determine crash risks. Recommended countermeasures will be determined to address high-risk areas and provide resources for future project planning to make Arkansas roads safer for all users.

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Bike Lending in North America: Understanding Business Models, User Acceptance, Social Equity, and Public Safety

Bicycle lending is a growing phenomenon within cities and towns across the country. Bike lending libraries allow people to check out bicycles, much like checking out a library book, for a set period of time and return it after the term is up or they have finished with it. Bike lending is different from bike rental or bike sharing in that most lending arrangements do not involve an exchange of money. Bike lending libraries exist to serve several different use cases and purposes. One of the main purposes of bike lending libraries is to allow people to use certain types of bicycles that they do not need all the time. To better understand the role and potential that bike lending libraries may have on the growth of bicycling as well as on the safety and social equity of access to riders, the research team first need an understanding of the scope and scale of bike lending initiatives across North America. This study will explore the topic by (1) conducting a literature review, (2) building an online census of bike lending operations in North America, (3) conducting expert interviews with operators, (4) conducting a survey of operators, and (5) conducting a focus group of users/lendees. The results will be synthesized in a final report.

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Pedestrian Level of Traffic Stress

Many of the existing methods to evaluate the suitability of pedestrian or bicyclist travel along roadway segments or crossing roadways require a large number of inputs, some of which are not available in typical roadway inventory data (e.g., on-street parking coverage, heavy vehicle proportion), making them impractical for most agencies to apply. Some of these methods also require statistical modeling expertise or specialized software to run. Occasionally, their outputs do not make intuitive sense. For these and other reasons, Bicycle Level of Traffic Stress (BLTS), a table-based framework from the Mineta Transportation Institute, has become a popular tool to assess roadway suitability for bicycling in the last decade. However, a similar Pedestrian Level of Service (PLTS) tool has not been established. The few table-based PLTS methods available today have been applied by separate agencies and use different inputs. This project will create a well-researched, standardized version of a table-based, Pedestrian Level of Traffic Stress (PLTS) tool. It will incorporate many of the most important and easy-to-collect roadway factors associated with pedestrian suitability from a) existing pedestrian suitability methods and b) the pedestrian safety literature.

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Evaluation of Innovative Pedestrian Detection Systems to Increase Safety

The project's objectives are described below: (1) Research the latest advancements in Dynamic Passive Pedestrian Detection (DPPD) or Automated Pedestrian Detector (APD) systems currently available and identify vendors with available products. This will build on the previous project where several products were identified and tested. (2) Develop evaluation, implementation, and data collection plans for investigating effectiveness of DPPD or APD systems to reduce pedestrians crossing without physically pressing a button

to place a pedestrian call. This will include investigation of a system where a pedestrian call can be placed via a smartphone or motion sensor so there is no need for the pedestrian to physically press the push button. (3) Complete a detailed evaluation on the effectiveness and benefits for using DPPD or APD systems in Florida via before-after studies of the behavior of pedestrians where such pedestrian detection technologies are deployed including investigation of extending or shortening the pedestrian crossing time at midblock crossings and canceling the pedestrian call depending on pedestrian presence at signalized intersections. (4) Develop implementation guidelines on when, where, and how to deploy these systems and document analysis results and research findings from the evaluation and provide recommendations.

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Optimization of Signal Timing Based on Pedestrian Intervals Using Computer Vision and Deep Learning Technology

This project is to conduct extensive use of computer vision based deep learning methodologies for detection, tracking and prediction of pedestrian movements. This will in turn aid in achieving the following objectives: (1) Increase pedestrian compliance with crossing phases by (a) Reduced wait times with skipped phases (b) Reduced false calls (2) Increase signal efficiency by (a) Reduced cycle length and split times to accommodate pedestrians (b) Reduced false calls (3) Identify a methodology and display to provide feedback to pedestrians that a call has been placed and the approximate wait time.

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