

Research Digest

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Item 1

Assessing the performance of the SpeedInfo sensor

OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

FHWA/OH-2013/21 • 2013

Until recently freeway traffic operations data were collected in house by the Ohio Department of Transportation (ODOT) using loop detectors. In recent years several private companies have emerged with a viable opportunity to outsource traffic data collection. While these new business models and ease of deployment are compelling, there are few published studies explicitly evaluating their performance. ODOT has contracted with two of these data providers: SpeedInfo and INRIX. This study exploited a unique juncture as ODOT transitioned to the new third party data collection: the two new systems and the legacy loop detectors were concurrently operational in Columbus, OH for approximately 6 months. Using the archived data from this period, we evaluated SpeedInfo and INRIX performance over a 14 mi. This long period of time ensured that we would have a better chance of observing intermittent features that might go unobserved in a short-term study.

Both SpeedInfo and INRIX traffic data generally performed within specifications, exhibiting small biases that could likely be fixed with fine-tuning. Both sensors also exhibited a reporting lag, on the order of 60 sec for SpeedInfo and 360 seconds for INRIX (comparable to conventional 60 sec and 5 min aggregation periods used in loop detectors). Although the lag and bias are within specifications, some applications might be sensitive to them, e.g., traffic responsive ramp metering. Each system also exhibited unique behavior not found in the other.

SpeedInfo is sensitive to precipitation: sometimes going offline for tens of minutes. When mounted on the shoulder, SpeedInfo showed slightly degraded performance on the far side traffic. INRIX reported speeds every minute, but after excluding repeated values, the actual effective reporting period was more like 3-5 min, with occasional periods of repeated measurements lasting in excess of 10 min (already reflected in the lag above). INRIX also provides two measures of confidence, neither of which reflects the measurement repetition.

This report is available for free download (15.1 MB):

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/2014/Planning/134723_FR.pdf

Item 2

Development of Strategic Enterprise Architecture Design for ODOT

OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

FHWA/OH-2014/3 • 2014

In order for the Ohio Department of Transportation (ODOT) to successfully carry out its mission, it is essential to appropriately incorporate and utilize technology. Information management systems are vital to maintaining the state's transportation infrastructure and are critical components for activities such as asset management, forecasting, QC/QA efforts, and data collection and analysis. The objective of this research is to develop a strategic enterprise architecture design for ODOT. To accomplish this task, the researcher completed an analysis and documented the 'as is' organization wide business processes and supporting information systems architecture at ODOT, and (2) made recommendations for a 'to be' future state business process and information system architecture. Based on the analysis, recommendations were provided for appropriate governance mechanisms and change management procedures.

This report is available for free download (11.2 MB):

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/2014/Aerial/134756_FR.pdf

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Item 3

The effects of combined supplementary cementitious materials on physical properties of Kansas concrete pavements

KANSAS DEPARTMENT OF TRANSPORTATION (KDOT)

FHWA-KS-13-5 • ©2013

This study evaluated the effects of combining varying proportions of slag cement and Class C fly ash with Type I/II cement in concrete pavement. Three different ternary cementitious material combinations containing slag cement and Class C fly ash (10% fly ash with 27% slag, 15% fly ash with 25% slag and 20% fly ash with 24% slag) were combined with limestone coarse aggregate and a moderately-reactive fine aggregate. Two concretes used only portland cement. Specimens of each concrete from the project were tested in the laboratory to evaluate physical properties. On-going pavement condition surveys will track pavement performance. All three ternary-blend concretes met specification requirements for the tests of alkali-silica reactivity. The 10% fly ash-27% slag combination was the most effective in preventing expansion. The 10% fly ash-27% slag concrete also had the highest strength and lowest permeability of the five concretes tested.

This report is available for free download (PDF):

<http://idmweb.ksdot.org/PublicLib/publicDoc.asp?ID=003831952>

Item 4

Evaluation of Long-Term Pavement Performance and Noise Characteristics of the Next Generation Concrete Surface

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT)

WA-RD 767.2 / WA 10-03 • 2014

This report documents the performance of the first Next Generation Concrete Surface (NGCS) built by the Washington State Department of Transportation (WSDOT). A 1,500 foot test section was installed on the eastbound lanes of I-82 near Sunnyside, WA in October of 2010. On-board sound intensity (OBSI) measurements increased from initial levels of 100.6 dBA to 104.4 dBA in 30 months. The increase in noise level was attributed to the loss of aggregate and general roughening of the concrete surface by studded tires. It was concluded that the NGCS is not a viable option as a noise mitigation strategy for Washington State.

This report is available for free download (1.3 MB):

<http://www.wsdot.wa.gov/research/reports/fullreports/767.2.pdf>

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Item 5

In-Place Voids Monitoring of Hot Mix Asphalt Pavements. Follow-Up

COLORADO DEPARTMENT OF TRANSPORTATION (CDOT)
CDOT-2013-19 • 2014

In order to validate the policy of allowing the adjustment of the asphalt cement to reduce the laboratory air voids up to one percent, cores were taken over a period of four years on 19 paving projects and tested for air voids. After being compacted by traffic over several years, the average air voids in these pavements were 3.8%. Since the design air voids are required to be between 3.5% and 4.5%, the monitoring validates the effectiveness of the policy. However, there was significant scatter in the data with most of the in-place voids falling out of this design range.

This report is available for free download (255 KB):
<http://www.coloradodot.info/programs/research/pdfs/2014/voids.pdf>

Item 6

Integration of Travel Demand Models with Operational Analysis Tools

VIRGINIA CENTER FOR TRANSPORTATION INNOVATION AND RESEARCH (VCTIR)
FHWA/VCTIR 14-R5 • 2013

Continuing growth in urban travel demand inevitably leads to a need for more physical capacity within the transportation system. However, limited financial resources, high construction costs, environmental considerations, long timelines, and an increasingly complex regulatory process have essentially rendered capacity-adding projects to be actions of last resort. Before such projects are undertaken, decision makers, planners, and engineers evaluate alternative operational improvement strategies that can eliminate, mitigate, or forestall the need for a more traditional highway construction project. Effectively evaluating the wide range of operational improvement strategies that are available is not a trivial matter, and this is particularly true when the performance of such strategies is compared to the construction of new lanes.

The purpose of this study was to recommend methods to obtain input data for operational analysis tools that operate as post-processors to travel demand models. Among all operational planning tools compatible with the four-step planning process, the Florida ITS Evaluation (FITSEval) tool was selected to be integrated with the primary planning software used by the Virginia Department of Transportation, i.e., Cube. To achieve the objective of this study, methods for estimating peak period flows from travel forecasting model outputs were investigated and Virginia data were examined for areas where planning forecasts and 24-hour travel patterns were available. Relationships between peak period flows and 24-hour data were studied. Procedures for obtaining the time-of-day factors for link and trip tables are provided using continuous count stations and National Household Travel Survey Data for Virginia. The modeling process was demonstrated by two case studies for the Hampton Roads area where the latest travel demand model was recently completed and many potential capacity enhancing operational strategies were available. Two case studies, Incident Management systems and HOT lanes deployment, were evaluated, and the results of the base case and operational strategy deployment scenarios were compared to make recommendations on the feasibility of the evaluated projects.

This report is designed to serve as a reference for users of FITSEval or similar operational analysis tools for evaluating operational capacity enhancements.

This report is available for free download (1.8 MB):
http://www.viriniadot.org/vtrc/main/online_reports/pdf/14-r5.pdf

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Item 7

Investigation of the Safety Effects of Edge and Centerline Markings on Narrow, Low-Volume Roads

VIRGINIA CENTER FOR TRANSPORTATION INNOVATION AND RESEARCH (VCTIR)

FHWA/VCTIR 14-R3 • 2013

Residency and regional traffic engineering staff of the Virginia Department of Transportation (VDOT) have postulated that the use of low-cost centerline and edgeline pavement markings, applied individually or in combination, can improve safety on narrow roads until higher cost, road-widening design improvements can be programmed and implemented. Mostly narrow secondary roads would fall in this category, but narrow primary roads would also be included.

The original purpose of this study was to develop a set of guidelines for VDOT traffic engineers to use when making decisions regarding the use of edgelines and centerlines on narrow, low-volume (less than or equal to 3,000 vehicles per day) roads. These guidelines were to be developed in a two-phase process, with the initiation of the second phase depending on the results of the first phase. This report describes the Phase I study, which included examining relevant literature; gathering information from other state departments of transportation; conducting a statewide inventory of edgeline and centerline markings; and performing a cross-sectional crash analysis of narrow roads identified in the inventory as (1) not having edge and centerline markings, (2) having both edge and centerline markings, (3) having edgeline markings only, and (4) having centerline markings only.

This report is available for free download (962 KB):

http://www.virginiadot.org/vtrc/main/online_reports/pdf/14-r3.pdf

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Item 8

Kansas Department of Transportation enterprise energy and carbon accounting and utility usage research phase 2B: improving energy and fuel efficiencies in KDOT operations

KANSAS DEPARTMENT OF TRANSPORTATION (KDOT)

K-TRAN: KU-12-5 • ©2014

Reducing the environmental impact of facilities and operations has become an important function for many organizations. In many cases, such as utility and fuel use, reducing these impacts can also be coupled to financial savings. The Kansas Department of Transportation (KDOT) has determined that conducting an energy and CO₂ audit of its building and vehicle fleets will aid in assessing KDOT energy use, prepare for any future regulations regarding CO₂ emissions, and help identify areas for increased savings through reduced use of commercial resources (primarily energy and fuel). Phase 1 of this project established baseline carbon and energy data from three major sources: the total energy embodied in the construction, operation and repair of KDOT-owned buildings, the total energy embodied in KDOT use of utilities (electricity, water and natural gas) and the energy expended in the operation of KDOT's vehicle fleet and other associated equipment. The work covered in this report (Phase 2) focused on streamlining and improving access to this information, improving KDOT's ability to track their data, and identifying areas for reducing expenditures on energy and fuel. Related Phase 2 work by Kansas State University to conduct energy audits of KDOT buildings is described separately in a report from that institution (published as K-TRAN KSU-12-5). Using the compiled data from Phase 1 of this project (site location, buildings, energy use, and building square footage), a web-based database was developed to manage information on the energy use and embodied energy of KDOT campuses and individual buildings. This database can be used to identify trends of campuses to find under-performing buildings, to aid in the tracking of high performance buildings, and also aid in verifying the upgrading of inefficient systems originally found by comparing the database with EIA baseline values. An operational energy use simulator (online at <http://www2.ku.edu/~sims/cgi-bin/KDOT/index.php>) was also developed for KDOT's long-term meter tracking use.

This system can show energy use by the state, district, city, county, and zip code. Using these tools and compiled records from the Phase 1 survey, we developed recommendations for projects to improve KDOT's energy efficiency and sustainability. These projects include LED fluorescent bulb replacements, retrofitting and upgrading existing HVAC systems to demand-controlled ventilation (DCV) systems, the use of lower embodied energy materials in new building projects, and changes in employee habits to conserve energy. Fuel use by KDOT from fiscal years 2006-2011 was analyzed using a Microsoft Access database created to manage and analyze entries more effectively. Analysis of records provided by KDOT showed an overall decreasing trend in total miles traveled and fuel consumed over this time period, but an increase in diesel use over the past several years. It also found that replacing older vehicle models with new models does not show the expected increase in vehicle fleet efficiency across all major vehicle types in the fleet. This is most likely due to increases in engine capacity and fuel consumption for similar model vehicles over the past decade. Using more efficient means of transportation can significantly decrease KDOT fuel demand, in particular replacing truck travel with car travel where possible. The report also outlines specific advantages and disadvantages of more extensive biodiesel use to meet federal renewable fuel requirements, and recommends specific actions to address potential issues that could arise due to biodiesel compatibility problems with some materials and difficulties in cold weather operation.

This report is available for free download (1.8 MB):

<http://idmweb.ksdot.org/PublicLib/publicDoc.asp?ID=003831956>

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Item 9

Peer exchange: journey from adequate to vital : the pathway to excellence

NEW MEXICO DEPARTMENT OF TRANSPORTATION (NMDOT). RESEARCH BUREAU
NM12SP-07-003 • 2013

This report documents the NMDOT Research Peer Exchange held April 10-11, 2013 in Albuquerque, New Mexico in accordance with the requirements of 23 CFR 420. It involved NMDOT staff and representatives from the state DOTs of Arizona, Ohio, Texas, Washington, and Wisconsin. The two key objectives of the peer exchange were to identify steps toward creating a Strategic Research Program that supports the Department's Strategic Plan and to develop strategies for overcoming operation obstacles. It included a review of the NMDOT research program and presentations from the other peer states on their programs. The peer exchange found that the NMDOT research program had made significant progress since the last peer exchange in 2008. The peer exchange recommended that the NMDOT should develop a Strategic Research Plan to guide their research project selection process; expedite the overall research project development process by conducting some steps simultaneously; develop a "Quick-Response Program" to address high-priority research needs; strengthen the implementation process for completed projects and develop outcome performance measures; develop a communication and marketing plan to transmit the value of the research program; and build productive partnerships with senior managers, customers, and stakeholders

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This report is available for free download (4.4 MB):

http://dot.state.nm.us/content/dam/nmdot/Research/NM12SP-07-003_PeerExchange_FinalReport.pdf

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Item 10

Real-Time Prediction of Vehicle Locations in a Connected Vehicle Environment

VIRGINIA CENTER FOR TRANSPORTATION INNOVATION AND RESEARCH (VCTIR)

FHWA/VCTIR 14-R4 • 2013

"The wireless communication between vehicles and the transportation infrastructure, referred to as the connected vehicle environment, has the potential to improve driver safety and mobility drastically for drivers. However, the rollout of connected vehicle technologies in passenger vehicles is expected to last 30 years or more, during which time traffic will be a mix of vehicles equipped with the technology and vehicles that are not equipped with the technology. Most mobility applications tested in simulation, such as traffic signal control and performance measurement, show greater benefits as a larger percentage of vehicles are equipped with connected vehicle technologies.

The purpose of this study was to develop and investigate techniques to estimate the positions of unequipped vehicles based on the behaviors of equipped vehicles. Two algorithms were developed for this purpose: one for use with arterials and one for use with freeways. Both algorithms were able to estimate the positions of a portion of unequipped vehicles in the same lane within a longitudinal distance. Further, two connected vehicle mobility applications were able to use these estimates to produce small performance improvements in simulation at low penetration rates of connected vehicle technologies when compared to using connected vehicle data alone, with up to an 8% reduction in delay for a ramp metering application and a 4.4% reduction in delay for a traffic signal control application.

This report is available for free download (2 MB):

http://www.virginiadot.org/vtrc/main/online_reports/pdf/14-R4.pdf

Item 11

Safety Performance Functions for Freeway Merge Zones

COLORADO DEPARTMENT OF TRANSPORTATION (CDOT)

CDOT-2013-12 • 2013

This report documents the results of a research project to support CDOT in the area of Safety Performance Function (SPF) development. The project involved collecting data and developing SPFs for ramp-freeway merge zones categorized as isolated, non-isolated and weave. For each of these three categories, data for the period 2007 to 2011 were collected at sites selected to ensure statewide geographical representation and coverage of the range of traffic volume and other variables in each category. The development of SPFs for the three categories of ramp-freeway merge zones was successful. Separate SPFs were developed for Total, fatal+injury (FI) and Property Damage Only (PDO) crashes.

This report is available for free download (338 KB):

<http://www.coloradodot.info/programs/research/pdfs/2013/spf.pdf>

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Item 12

Synthesis of Best Practices for Determining Value of Research Results

LOUISIANA TRANSPORTATION RESEARCH CENTER (LTRC)

Final Report 512 • 2014

"The overall objective of this project is to synthesize the best practices for determining the value of research results in order to demonstrate the impact that the research has on transportation system features, such as safety, quality, and cost effectiveness. This synthesis presents a critical review of methods used for determining the value of transportation research. Furthermore, it is intended to identify various measures and data sources used for determining the value of research."

This report is available for free download (5 MB):

http://www.ltrc.lsu.edu/pdf/2014/FR_512.pdf