Indiana Department of Transportation Use of Third-Party Data for Work Zone Management

SMARTER WORK ZONES TECHNOLOGY APPLICATIONS CASE STUDY

The Every Day Counts Initiative (EDC-3) aims to accelerate the deployment of identified, but underutilized innovative practices that focus on reduced project delivery schedules, increased roadway safety, reduced congestion, and/or enhanced environmental sustainability. Smarter Work Zones (SWZ) is one of three EDC-3 initiatives focused on safety and mobility, and was developed to promote safe and operationally efficient work zones through project coordination and technology application strategies.

This case study focuses on technology applications for work zone data collection by the Indiana Department of Transportation (INDOT). Technology applications involve deployment of intelligent transportation systems (ITS) for dynamic management of work zone traffic impacts to improve motorist and worker safety and mitigate work zone-related congestion.

Background

INDOT began experimenting with alternate data collection technologies in 2011, including third party data. Structural issues prompted a five-month emergency closure of the I-64 Sherman Minton Bridge over the Ohio River, which serves as a major commerce route between Indiana and Kentucky. Major traffic detours onto neighboring routes were implemented which resulted in INDOT's need for data to monitor traffic conditions. For this effort, INDOT contracted with a third-party data provider specifically to monitor conditions and make operational changes as conditions warranted. Soon after, INDOT made a decision to acquire third-party data for statewide traffic management activities, to have better coverage and penetration for monitoring conditions on roadways where sensors do not exist and are cost-prohibitive. Third-party data were soon leveraged for a number of work zone-specific applications that have proven to be successful.

Assessment of Needs, Concept Development, and Design

INDOT recognized the importance of asking the following questions for a comprehensive understanding of data needs, prior to acquiring statewide third-party data:

- What is the purpose for the data?
- What are the goals and what will be accomplished though acquiring data?
- How will it be used (tools, processing, decision-making) once it is obtained?

These questions helped INDOT to determine the tools needed to process the large volume of third-party data being acquired, and also to maximize the likelihood that acquiring the data would result in benefits for the agency and for the traveling public.

As part of this effort, INDOT identified several transportation management areas throughout the agency, including work zone management, where third-party data could enhance existing analysis and performance measurement practices. By identifying multiple applications across INDOT divisions, it helped to justify third-party data investment costs.

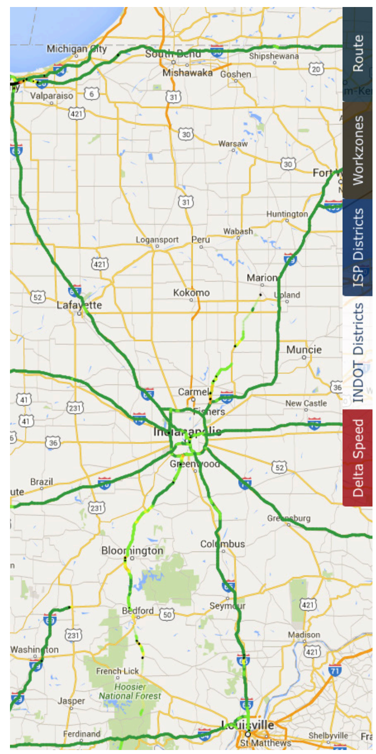

Figure 1: INDOT has a number of tools for work zone management that leverage third-party data. *Source: INDOT*

For the first two years, INDOT procured one- to two-day-old statewide historical data and developed tools to process and leverage this data for various traffic issues. In 2014, after becoming more comfortable with the third-party data and in order to address safety and mobility impacts as they occur, INDOT began procuring real-time data products from the same third-party provider. Because the usefulness of historical data had been successfully demonstrated, the decision to acquire real-time data was met with little resistance.

Procurement

Selection of the data provider is based on identified data needs. Major factors that INDOT considered when selecting a data provider included:

- Availability of data with the required spatial and temporal resolution,
- A robust customer probe database, and
- Anonymous and untraceable data, to avoid privacy concerns.

Leveraging Relationships

The Joint Transportation Research Program (JTRP) is an established research partnership between INDOT and Purdue University (http://www.in.gov/indot/2700.htm). The third-party data is able to be viewed by both Purdue University researchers and INDOT traffic management officials, who collaboratively analyze the data and investigate innovative applications. Though not part of the JTRP, the third-party data provider contributes to the effort by modifying the format of datasets as needed to use in developed tools. Leveraging the JTRP relationship has resulted in several major achievements:

- Formation of new and better tools to analyze and display third-party data;
- Assessing mobility and making operational changes to improve mobility; and
- Promoting the implementation of modems for traffic signal control and data collection.

Another factor for consideration is whether the third-party data provider has the technical expertise to build tools for processing raw data and providing it in a usable format. INDOT opted to purchase only raw data, and developed its tools for interpreting and displaying the data in-house.

Data providers, to a certain extent, are flexible in providing tailored data products. Among the factors that affect the cost of third-party real-time data include:

- Total mileage of roadways to be covered by probe data,
- Time resolution of the data,
- Provision of tools and/or dashboards, and
- Whether the data is historical or is received in real-time.
- Desired segment lengths, for travel time calculation

INDOT currently purchases data for all interstates in the state, plus 200 miles of other major non-interstate roadways that are flexible, as needed. That is, the service provider can easily alter the 200 miles of non-interstate route data that is provided, as needed by INDOT for various purposes.

Using Third-Party Data to Plan, Assess, and Modify Work Zone Operations

INDOT noted that both historical and real-time third party data has been a worthwhile investment. The data has been used for a variety of work zone applications on several projects detailed in sections below, and has proven to be very successful in identifying operational changes to improve traffic conditions.

Leveraging existing resources

INDOT did not procure third-party data specifically for work zone management. Third-party data has been used for signal re-timing, decisions regarding bypass construction, and calculation of user delay across the road network, and was later leveraged for work zone management applications. It is easier for work zone programs to access third-party data if the agency already has a relationship with a vendor to purchase the data. Work zone programs can benefit from that arrangement to leverage existing resources within the agency.

Managing Congestion during an Unplanned Closure: I-65 at Wildcat Creek example

A major unexpected bridge closure on northbound I-65 over Wildcat Creek in August 2015 resulted in a month-long 60-mile detour for interstate traffic. The primary reason for such a long detour was to prevent routing traffic through the City of Lafayette. The detour route utilized portions of US-52, State Route 28, and US-231 and experienced congestion in several locations, severely impacting mobility through the area.

Limited information from field sensors was available to understand the impacts along the detour route. To address the lack of operational data, INDOT made a request to the third-party data provider to obtain traffic information for the detour route. The availability of third-party data eliminated the cost of installing additional field sensors, and provided sufficient coverage and resolution for assessing operations along the typically lesser-traveled route. INDOT and Purdue University assessed historical third-party data to determine the average travel time to be about 3.5 hours along the detour route on the first day. INDOT and Purdue University then used the third-party real-time (every minute) segment speed data to examine detour operations and identify solutions at specific problem areas. Several changes were made to improve operations along the detour route:

- Erecting temporary signals (two signals installed within 30 hours).
- Installing wireless modems on signals that did not previously have them to remotely adjust signal timing in real-time and get fine resolution signal data.

- Adjusting signal timings. Specifically, progression for a 10-12 signal system was changed from two-way to one-way progression to account for directional demand.
- Mounting temporary cameras.

Real-time third-party data enabled informed signal timing changes to be made based on current conditions with the capability to see how those operational adjustments affected traffic.

Travel times along the detour route decreased to 90 minutes after a week with these implemented solutions in place. Day-to-day differences were noted at the locations where changes were being made. Further modifications were made to operations in the second week, causing travel times to decrease even further to about 70 minutes. Data from the third-party data provider, signal data coming from the modems, and video feeds coming from cameras in the field provided verification that operational improvements were a result of changes made to the traffic control devices.

Managing Unexpected Congestion during a Planned Closure: The South Split Project Example

In 2013, the South Split Project[1] detoured traffic traveling through Indianapolis on I-65 or I-70 to the outerbelt (I-465). Additional traffic on the detour route resulted in backups in locations where congestion would otherwise not typically occur. Performance dashboards for the project were created to assist TMC staff in identifying congested conditions, and posting messages on DMSs regarding unexpected backups, and to change signal timings on off-ramps to prevent queues from propagating onto the interstate mainline. Figure 2 shows the increased number of hours with slower traffic speeds from milepost 0 to 12 due to the work zone in September and October 2013 (callout “i”), a return to previous conditions in November after work concluded (callout “ii”), and slower traffic conditions that resulted from winter weather in December (callout “iii”).

Modifying Construction Schedules: Examples on I-94 and I-65

Third-party data can also be used to adjust the construction window based on the assessment of mobility. For example, a construction project on I-94 east of Chicago exhibited unused capacity, as indicated by third-party data. To take advantage of the unused capacity, construction hours were expanded, which would allow construction to finish earlier than anticipated and resulted in a decrease in project cost.

Additionally, third-party data was used to determine that freeway expansion and bridge rehabilitation project on I-65 in Seymour, IN resulted in delays that were longer than originally forecast. Though impacting construction efforts, construction hours were reduced during the periods where congestion was most pronounced to increase mobility.

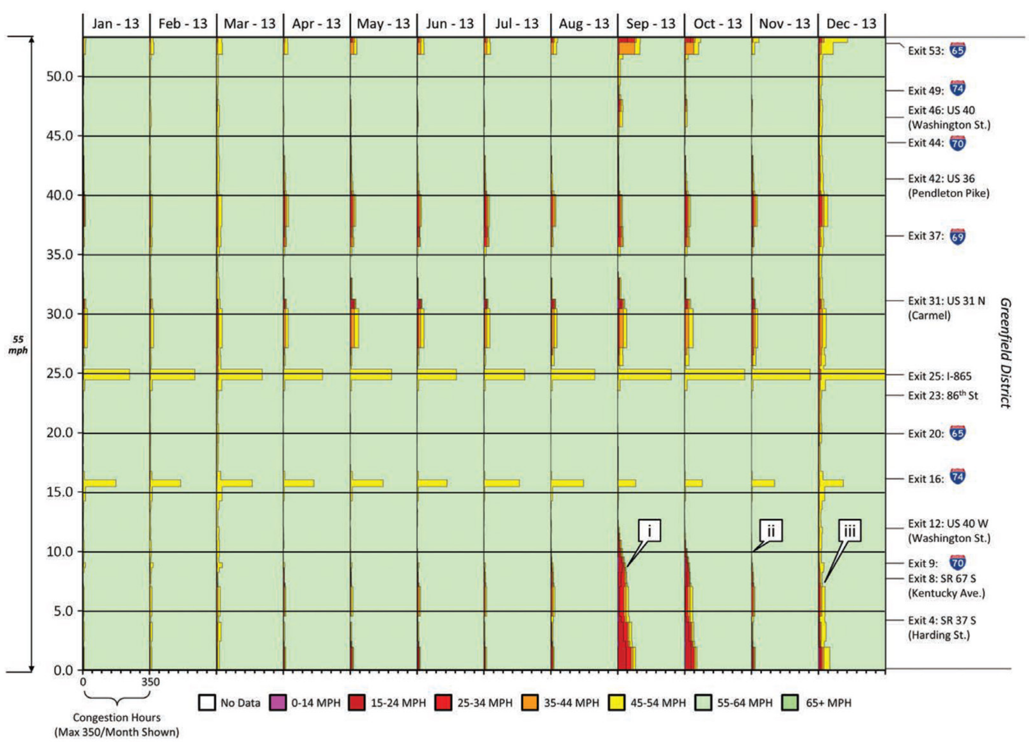

Figure 2. Monthly speed profiles for the I-465 outerloop in 2013, showing the increase of congestion hours during the South Split detour in September and October. *Source: INDOT1 Monitoring Work Zone Mobility*

In both cases, the third-party data provided verification that changing the hours that the work zone was active would allow mobility to be maintained. The data was also able to confirm that shortening the duration of construction would improve mobility.

1 http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1006&context=imr

Assessing a Work Zone Traffic Control Plan: I-65 Overpass at US-231 Example

A different work zone project involved an assessment of the traffic control plan for I-65 overpass work at US-23[2]. Due to construction activities, traffic would not be able to use the overpass. Because the overpass under construction was at an interchange, it was possible to re-route traffic to the off-ramp upstream of the overpass, across US-231, and back onto the freeway (downstream of the construction site) using the on-ramp. Two lanes were maintained on the ramps, access to US-231 was restricted, and the speed limit was reduced to 35 mph. Historical third-party data was used to assess the feasibility of diverting overpass traffic to off-ramp and on-ramp. It was found that mobility could maintained using the off-ramp/on-ramp strategy. Third-party data was used to confirm that no drastic reduction of speeds were experienced during construction.

Establishing Work Zone Business Practices for Third-Party Data

The use of third-party data is becoming an integral part of INDOT business practices. Since first procuring third-party data in 2011, INDOT has successfully used it for a variety of applications that have demonstrated value to justify continued and expanded use for work zone management. The closure of the I-65 bridge over Wildcat Creek in Lafayette verified the utility of third-party data for improving mobility during a major construction closure, and INDOT has continued to use third-party data to perform work zone mobility assessments to make important operations and traffic control decisions on other work zone projects.

The scope for uses of the third-party data continues to expand, as new tools continue to be developed for using the data based on agency needs. Research is being conducted to examine the segment length and minimum sampling requirements for reliable third-party data in various applications, and several work zone management tools currently being developed for third-party data, include:

- A tool to identify when a speed difference of 15 mph or greater between segments is noted. These alerts will be particularly useful in areas where queues are not typically expected, including, but not limited to work zones.
- A point-and-click tool for setting up work zones and collecting data within its bounds.
- A feature that allows a user to specify areas of interest so that only alerts from the specified areas are received. Currently, tool users receive all alerts.

Conclusions

This case study illustrates one example of work zone technology applications. INDOT applications of third-party data show the benefits of collecting and analyzing work zone data for improved mobility. Several specific lessons learned from INDOT's experiences on this technology application include:

- Have clear expectations on needs and what to do with the data once it is received. The proper tools to handle the data need to be in place once third-party data feeds are activated.
- Leverage existing resources: third-party data is used for other agency purposes, such as everyday traffic management and evaluation of signal re-timing and bypass construction, which helps to justify the investment;
- Leverage existing relationships with research programs to identify and develop innovative solutions for program needs and gaps. Existing relationships with Purdue University researchers, and their reputation for conducting quality research facilitated the use of third-party data in work zone applications. INDOT saw value in the research efforts, and the existing relationships allowed INDOT to be comfortable with the research results.

Additional resources on SWZ technology application strategies can be found at: https://www.workzonesafety.org/swz/technology_application

2 http://www.in.gov/activecalendar/EventList.aspx?view=EventDetails&eventidn=220967&information_id=214728&type=&syndicate=syndicate

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