

NORTH/WEST PASSAGE



August 2016

Evaluate the Effectiveness of Citizen Reporting

Project 10.3



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EXECUTIVE SUMMARY

The purpose of this project was to conduct an evaluation to document the experiences, benefits, costs and lessons learned of multiple agencies using citizen reporters to enhance road reports provided by state Departments of Transportation (DOT). Two types of citizen reporting approaches were reviewed.

State DOT Operated Citizen Reporting Programs – DOTs that developed a citizen reporting program in-house and operate and maintain the system. This includes recruiting and training citizens, developing an input mechanism for citizens to input reports, and displaying reports on DOT traveler information dissemination systems.

State DOT Data Sharing with Waze for Citizen Reporting – Waze is a third party data provider that allows drivers to share real-time traffic and road information that is then posted on their navigation app. DOT post selected information gathered by Waze to supplement road condition information on their traveler information websites through an agreement with Waze. In exchange, DOTs provide real-time traffic data to Waze.

To gather the information for this evaluation interviews were held with the following states through phone calls or email exchange as well as through an online search.

- State DOT Operated Citizen Reporting Programs
 - Idaho Transportation Department
 - Minnesota Department of Transportation
 - Utah Department of Transportation
 - Wyoming Department of Transportation

- State DOT Data Sharing with Waze for Citizen Reporting
 - Kentucky Transportation Cabinet
 - Iowa Department of Transportation
 - Oregon Department of Transportation

This report summarizes the need to develop a citizen reporting Idaho, Minnesota, Utah, and Wyoming identified as well as the benefits, costs, and lessons learned from operating an in-house citizen reporting program. In addition, this report summarizes the experiences of Kentucky, Iowa, Oregon that are accomplishing citizen reporting through agreements with Waze. Overall key findings from each citizen reporting approach are also documented.

1.0 INTRODUCTION

Typically, state DOTs operate a road condition reporting system that inserts information and road conditions from a variety of manual and automated feed sources. The information is then disseminated to the traveling public through a variety of mechanisms including websites, 511 phone systems, and mobile applications. For example, DOT maintenance staff may enter a report into a road condition reporting system that a section of road is icy. The report is then disseminated to the public.

Many of the North/West Passage states (Idaho, Minnesota, Montana, North Dakota, South Dakota, Washington and Wyoming) face challenges with providing frequent and updated road condition reports through their reporting systems, especially in rural areas. To address this challenge, some states are utilizing citizens as reporters to enhance the frequency of road reports which continues to be of interest to the North/West Passage members.

The focus of this project was to conduct an evaluation to document the benefits, costs, and lessons learned of agencies using citizen reporters to enhance the information sources that feed road condition reporting systems. This report summarizes the experiences of multiple states that utilize citizens for road reports. For this evaluation two different citizen reporting approaches were reviewed.

- ***State DOT Operated Citizen Reporting Programs*** – DOTs that developed a citizen reporting program in-house and operate and maintain the system. This includes recruiting and training citizens, developing an input mechanism for citizens to input reports, and displaying reports on DOT traveler information dissemination systems.
- ***State DOT Data Sharing with Waze for Citizen Reporting*** – Waze is a third party data provider that allows drivers to share real-time traffic and road information that is then posted on their navigation app. DOT post selected information gathered by Waze to supplement road condition information on their traveler information websites through an agreement with Waze. In exchange, DOTs provide real-time traffic data to Waze.

In order to evaluate the benefits, costs, and lessons learned of agencies utilizing citizen reports to enhance DOT provided traveler information, states with DOT operated citizen reporting programs as well as states with data sharing agreements with Waze were interviewed through phone calls or email exchange. Additional information was gathered through an online search.

This report includes the following:

- [2.0 Background](#) – Background information on the North/West Passage Transportation Pooled Fund Study and citizen reporting efforts completed by its members.
- [3.0 Evaluation Goals and Objectives](#) – Description of the goals and objectives of this evaluation.
- [4.0 Citizen Reporting: State DOT Operated](#) – Summarizes the need to develop a citizen reporting program that Idaho, Minnesota, Utah, and Wyoming identified as well as the benefits, costs, and lessons learned from operating an in-house citizen reporting program.
- [5.0 Citizen Reporting: State DOT Data Sharing with Waze](#) – Summarizes the experiences of several DOTs that are accomplishing citizen reporting through agreements with Waze.
- [6.0 Conclusions](#) – Provides an overall conclusion of key findings from state DOT operated citizen reporting programs and from state DOTs data sharing with Waze for citizen reporting.

2.0 BACKGROUND

The [North/West Passage Transportation Pooled Fund Study](#) focuses on cross-border Intelligent Transportation Systems (ITS) coordination along the I-90 and I-94 corridors through the states of Washington, Idaho, Montana, Wyoming, North Dakota, South Dakota, and Minnesota. See **Figure 1**. Over the past several years the North/West Passage member states have concentrated one of their endeavors on learning and sharing citizen reporting efforts.



Figure 1: North/West Passage Members

In 2006, the Wyoming DOT (WYDOT) successfully developed and deployed an Enhanced Citizen Assisted Reporting (ECAR) program that allows authorized citizens to manually report driving conditions to DOT staff who then enter the events into the department's statewide reporting system for dissemination on 511 and the web. Additional details of Wyoming's ECAR program were of interest to the North/West Passage states and in 2011, details of Wyoming's ECAR program were shared with the other states. A [Citizen Reporting Feasibility Study](#) was then completed by North/West Passage to explore ways in which Wyoming's program could be improved upon for maximized success in future implementations and to explore the feasibility of the citizen reporting system expanding to additional states.

The Idaho Transportation Department (ITD) developed and implemented a citizen reporting system in 2013 that was modeled after the Wyoming system but allows authorized citizens to report conditions through a web interface.

With the ultimate goal of consistent reporting across state boundaries and the potential for long distance travelers to report conditions for both Wyoming and Idaho, North/West Passage helped the two states work together to develop [common reporting phrases and definitions for citizen reporting](#). The common phrases were identified by first reviewing those used in the initial WYDO ECAR program, then by reviewing the phrases recommended by an earlier North/West Passage project ([Corridor-Wide Consistent Major Event Descriptions](#)), and finally by reviewing the phrases used by ITD. Detailed discussions about the use of common phrases allowed ITD and WYDOT to come to an agreement on a small list of phrases that were seen as manageable for citizen use.

In October 2014, a [peer exchange webinar](#) was held by the North/West Passage members to continue to discuss states' interests in citizen reporting and to review the approaches and experiences with citizen reporting in Wyoming and Idaho. During the webinar, the Minnesota DOT (MnDOT) shared that they were launching citizen reporting in Minnesota with DOT staff reporting conditions starting in November 2014.

Based on the continued interest of the North/West Passage members, this project "Evaluate the Effectiveness of Citizen Reporting" was approved by the members in 2015 to continue to learn the benefits and lessons learned of citizen reporting as well as document other approaches such as third party data use for citizen reporting.

3.0 EVALUATION GOALS AND OBJECTIVES

The goals and objectives in the table below were established for evaluating multiple states using citizen reporting for this project.

Table 1: Evaluation Goals and Objectives

Goal	Objectives
Goal #1: To understand the costs of implementing citizen reporting systems	<ul style="list-style-type: none"> • To document costs of system deployment • To document citizen training costs • To document costs of operation
Goal #2: To understand the benefits of implementing citizen reporting systems	<ul style="list-style-type: none"> • To document the overall system use • To document impacts of citizen reporting
Goal #3: To understand lesson learned from the citizen reporting process	<ul style="list-style-type: none"> • To document lessons learned in the process of establishing the citizen reporting system • To document lessons learned in operating / maintaining the citizen reporting system • To document specific lessons learned from states partnering with 3rd Party vendors for citizen reporting

4.0 CITIZEN REPORTING: STATE DOT OPERATED

One approach for citizen reporting is for DOTs to develop, operate, and maintain a program in-house. In order to accomplish such a program, upfront planning and coordination within the DOT is necessary before moving forward with implementing and deploying a system. DOTs address issues such as staffing, institutional issues, and funding issues to plan the citizen reporting program and detailed plan. Additional elements of the plan include details on recruitment of citizens, training of citizens, and quality control. Other areas include developing an input mechanism for citizens to make reports, identifying modifications to the road condition reporting system to display citizen events, and identifying what information should be included in a citizen report. These are just a few examples of the different aspects DOTs review as they plan for and then implement a citizen reporting program.

Four states with established citizen reporting programs were contacted via phone or email interviews to participate in this evaluation. The following sections summarize the need each state identified for developing a citizen reporting program followed by the benefits, costs, and lessons learned from operating a citizen reporting program in-house as outlined in the evaluation goals above.

- Idaho Transportation Department
- Minnesota Department of Transportation
- Utah Department of Transportation
- Wyoming Department of Transportation

4.1 Background and Need

Each state DOT reviewed for this project developed a citizen reporting program based on improving the frequency and coverage of road condition reporting. **Table 2** below provides background information on the four states reviewed for this project and describes the needs each state identified for improved road condition reporting. The table also notes the year citizen reporting was established. For example, ITD had a number of complaints from the public regarding out of date information. Based on this feedback, Idaho identified a need to improve the timeliness and frequency of winter road condition reporting. Idaho established a citizen reporting program in 2013.

Table 2: Background and Need for Improved Road Condition Reporting and Year Citizen Reporting Program Established

State	Background and Need	Year Established
Idaho	ITD’s winter road condition reports are radioed in by maintenance crews at least daily and as conditions change, however, it is difficult to track the reliability of “as conditions change” reporting. Individual reports are time tagged with a 24-hour lifespan or until overwritten. Due to complaints from the public regarding out of date information, ITD identified a need to improve the timeliness and frequency of winter road condition reporting.	2013
Minnesota	MnDOT identified a need for more timely and accurate road condition information to serve the more than 5,000 people who access their travel information website daily for road condition information during the winter. There are more than 700 traffic cameras in the Twin Cities metro area to check the condition of metro highways and monitor traffic incidents, but in Greater Minnesota there are far fewer cameras and those that are present are designed for incident management and traffic monitoring.	2015 - Phase 1 2016 - Phase 2
Utah	Utah DOT (UDOT) maintenance staff and DOT meteorologists collect road and weather information; however, there are locations statewide that have experienced information gaps where road and weather information is unavailable and where there are no traffic cameras or Road Weather Information System (RWIS) units. UDOT identified a need for more timely and accurate road condition information to supplement Utah’s existing reporting.	2012 - Pilot 2013 - Full Launch
Wyoming	WYDOT maintenance staff provides road condition reports, however, with much of the state being rural there are many challenges in obtaining timely reports. Maintenance staff is unable to report on and cover the entire state resulting in WYDOT identifying a need for an additional source to provide more timely and accurate traveler information.	2005 - Pilot 2006 - Full Launch

Various options were reviewed to meet the needs identified in **Table 2** to populate the DOTs’ condition reporting systems with additional consistent, reliable, accurate, and timely information of road and weather conditions. Options reviewed included additional maintenance reports, additional sensors, and citizen reporting. WYDOT found that additional maintenance reports were costly and installing more sensors was both costly and limiting, but citizen reporting was inexpensive and flexible. Third-party data providers that allow drivers to share real-time road information similar to state DOT citizen reporting

programs were not researched as an option. The states found it difficult to identify a third-party data provider with extensive data in rural areas at the times their citizen reporting program was established. After reviewing their options, each of the four states moved forward with developing an in-house citizen reporting program to meet their state's need for more timely road reports.

4.2 Implementation Costs

Evaluation of the costs to implement DOT operated citizen reporting systems involved documenting the actual costs incurred by ITD, MnDOT, UDOT, and WYDOT. At the highest level, citizen reporting system costs can be defined into three categories:

1. **Costs of System Deployment.** System deployment costs include planning the overall approach to citizen reporting and creating any custom software or hardware to be used by citizen reporters or the DOT representatives receiving the reports. These costs typically involve staff hours to plan key aspects of the system, such as: the reporting mechanism citizens will use, any geographic or driving pattern considerations that will be included in citizen recruiting, the types of conditions to be reported, and what information to filter.
2. **Citizen Recruiting and Training Costs.** Once the citizen reporting system is launched, another cost is recruiting and training the citizen reporters. These costs may include staff time to prepare and update training materials as well as staff time to interact with citizen reporters.
3. **Operation and Maintenance Costs.** Depending upon the approach to citizen reporting, the public agency may either operate a software system that citizen reporters interact with or may rely upon telephone calls with DOT staff.

The following figures include highlights from interviews conducted with the four states related to the implementation cost categories noted above and key findings for each category.

IMPLEMENTATION COSTS - SYSTEM DEPLOYMENT

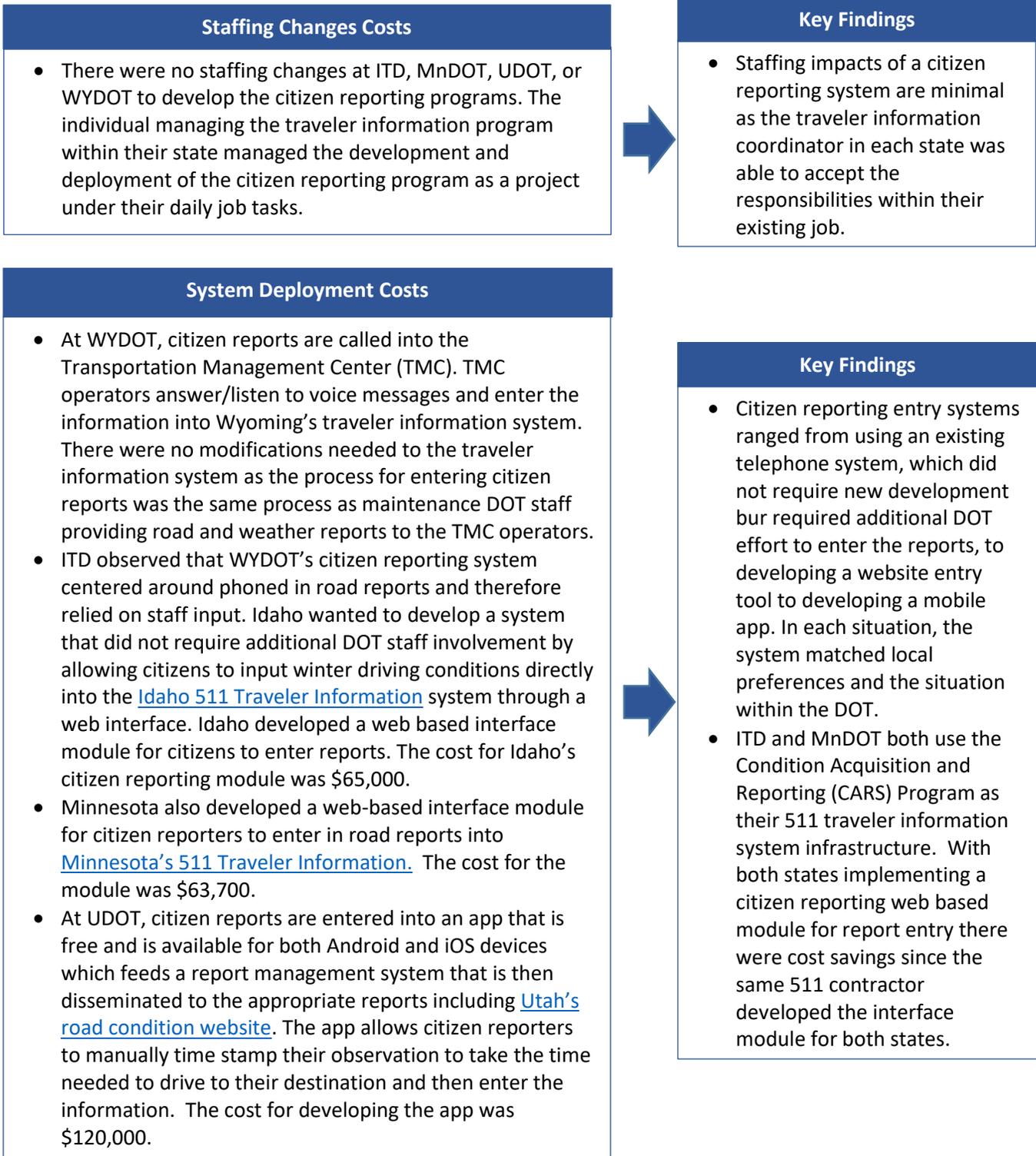


Figure 2: System Development Costs and Key Findings

IMPLEMENTATION COSTS - CITIZEN RECRUITING AND TRAINING

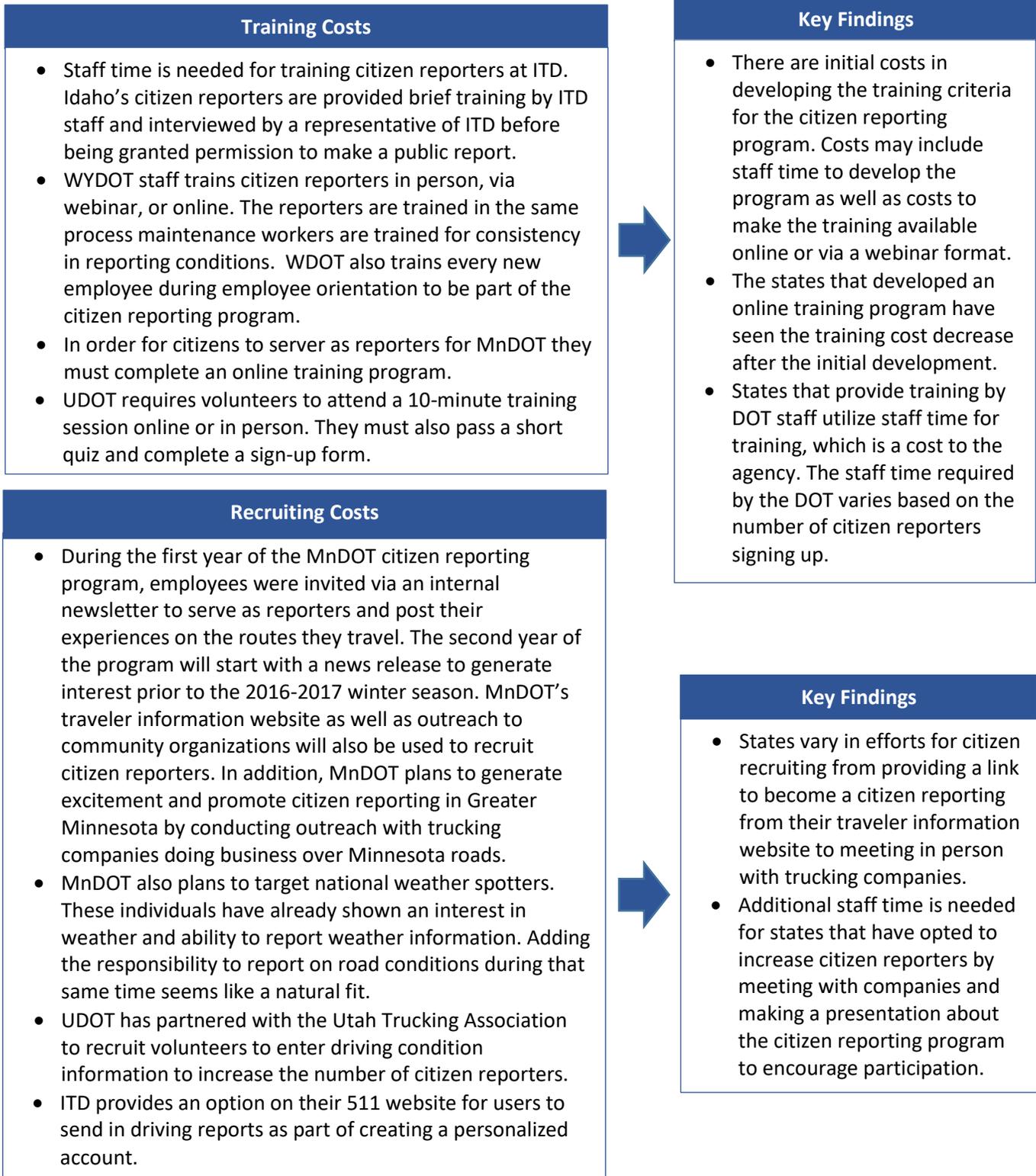


Figure 3: Citizen Recruiting and Training Costs and Key Findings

IMPLEMENTATION COSTS - OPERATIONS AND MAINTENANCE

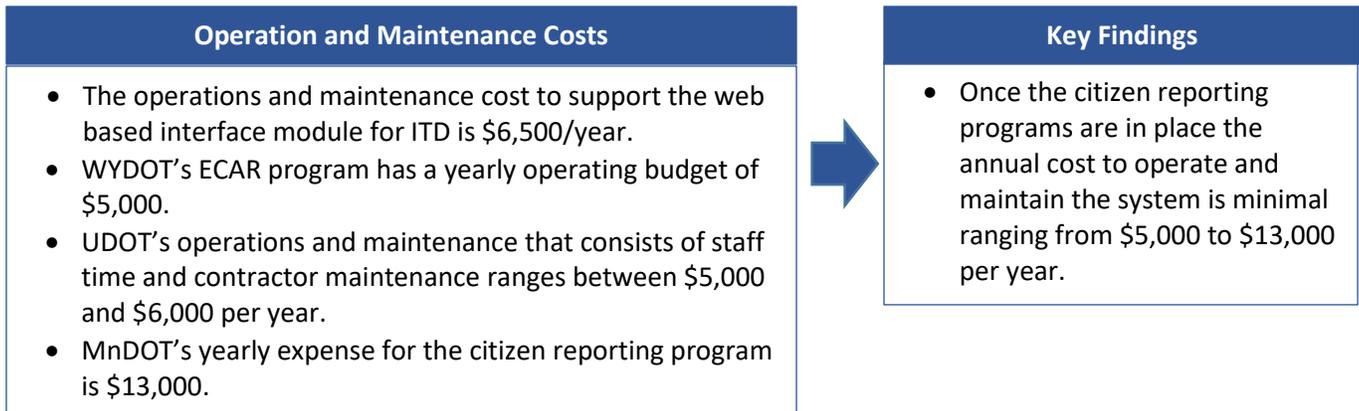


Figure 4: Operations and Maintenance Costs and Key Findings

4.3 Benefits

To understand the benefits that ITD, MnDOT, UDOT, and WYDOT have experienced from implementing citizen reporting within their state the overall system use and impacts were documented.

1. **Overall System Use.** Once the citizen reporting program is launched there are a number of factors for the use of the system. This includes the number of citizen reporters, number of reports, and number of roads reported.
2. **Citizen Reporting Impacts.** Impacts of citizen reporting include changes or timeliness of reports to the public and may also include changes in DOT staff time spent monitoring and reporting conditions.

The following figures include highlights from interviews conducted with the four states related to overall system use and impacts as well as key findings for each area.

BENEFITS - OVERALL SYSTEM USE

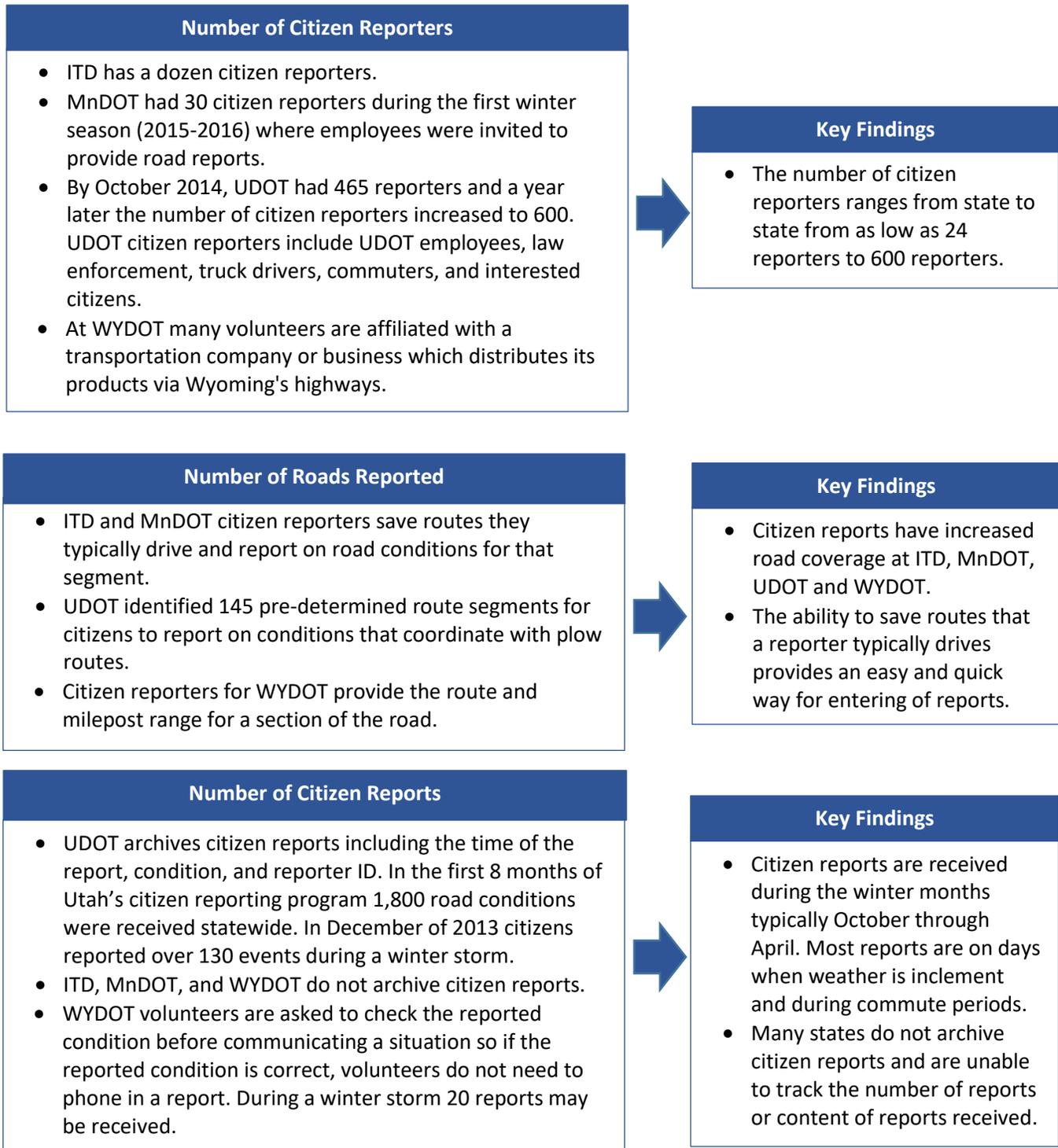


Figure 5: Overall System Use Interview Highlights and Key Findings

BENEFITS - IMPACTS

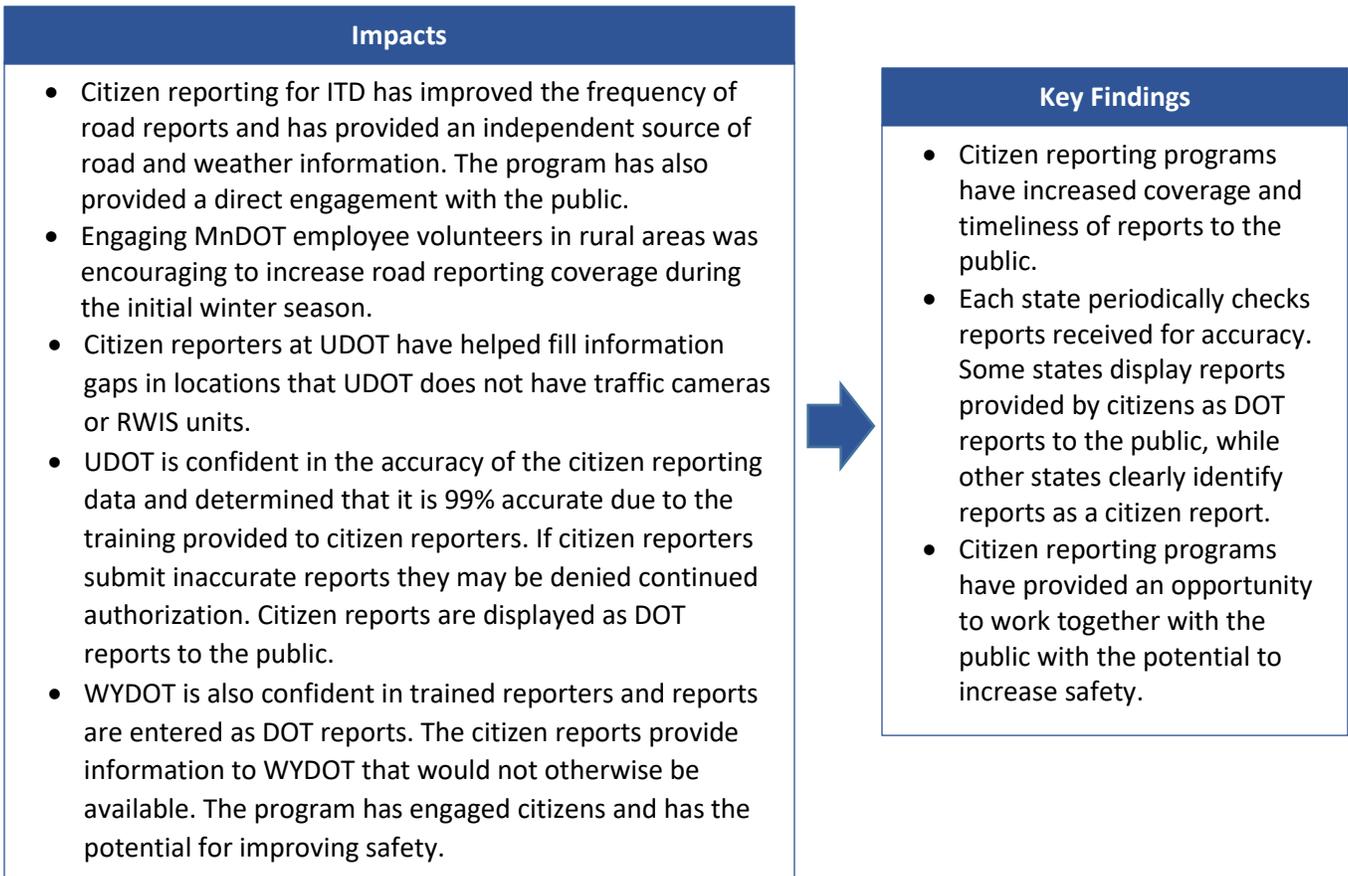


Figure 6: Impacts - Interview Highlights and Key Findings

4.4 Lessons Learned

As each state has developed their citizen reporting program a number of lessons learned were shared. Since some of the reporting systems reviewed for the evaluation have newer programs implemented in the last few years they are continuing to learn and improve each year their system is operational. The following figure includes noted lessons learned from interviews as well as key findings.

LESSONS LEARNED

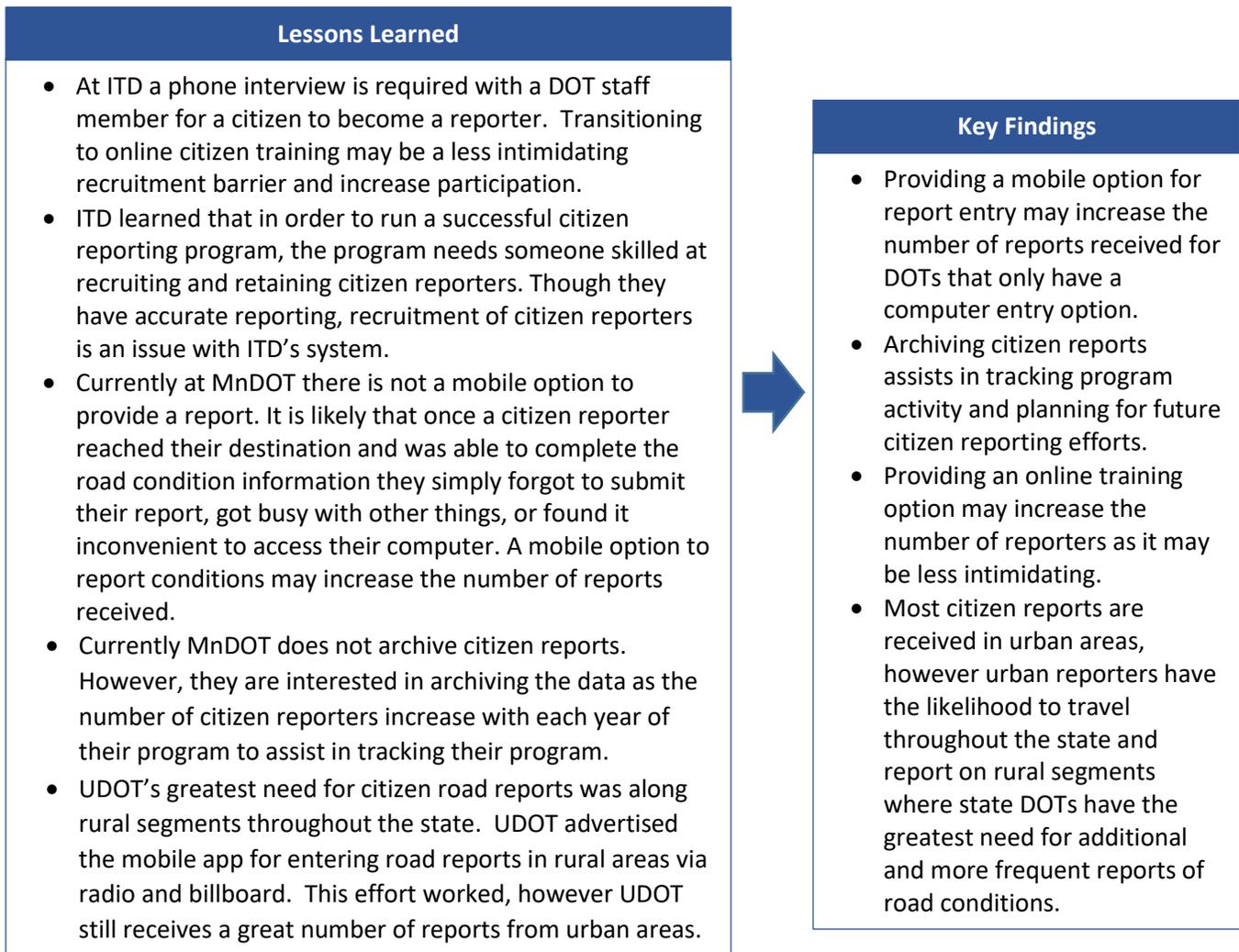


Figure 7: Lessons Learned - Interview Highlights and Key Findings

4.5 Summary of Key Findings

The following bullets provide an overall summary of the key findings found related to benefits, costs, and lessons learned described in the sections above of state DOT operated citizen reporting programs.

- State DOT operated ***citizen reporting programs are a relatively new effort*** to three of the states that participated in this evaluation (ITD, MnDOT, and UDOT) with each only having 1 to 3 years of experience with their program. However, WYDOT is a well-established program deploying a citizen reporting program over 10 years ago.
- All four states identified a need to improve the timeliness and frequency of road condition reporting especially ***during the winter season***. The states with urban areas such as Minneapolis-St. Paul in Minnesota are instrumented with various devices (e.g. traffic cameras, detectors) that provide or assist in providing accurate and timely road and weather reports through their road condition reporting system. However, all four states reviewed for this project also identified a need to supplement reports in ***rural areas*** and ***outside of business hours***. In rural areas, maintenance staff resources are unable to report on and cover routes in a timely manner.
- All four states had a need for additional road reports, but found it difficult to identify ***third-party data providers with extensive data in rural areas at the time their reporting programs were developed***.
- There are a ***variety of costs*** to a state DOT with the deployment of a citizen reporting program. ITD, MnDOT and UDOT developed reporting systems that do not require additional DOT staff involvement in the process of reporting by allowing citizen to input driving and weather conditions through a web interface (MnDOT and ITD) or app (UDOT). WYDOT citizen reporters phone in reports to the TMC and this process requires additional DOT efforts to enter the condition reports.
- State DOTs that only allow report entry only through a laptop or desktop computer may be inconvenient for reporters. ***Mobile options for entering road reports may increase the number of reports received***.
- DOTs planning a citizen reporting system need to determine how the reports will be implemented into current road condition reporting systems. This may involve ***working with the state's 511 contractor*** to modify the road condition reporting system to allow citizens to report conditions. These types of modifications to the systems may include presenting reports entered from citizens with a different icon from other reports (or distinguishing text). Similarly, citizen reports may require verification from a DOT staff member. Depending upon the changes to the system, these changes may require additional funds.
- ***Staffing impacts on the four states reviewed were minimal*** as the traveler information coordinator in each state was able to accept the responsibility within their existing job.
- States vary in how they conduct training. Some states only provide an online training option while others may provide or require training with DOT staff. ***Providing an online training option may be less intimidating and increase participation***.
- There are initial costs in developing the training criteria for citizen reporters. However, states that developed ***online training programs have seen the cost decrease after the initial***

deployment. States that provide training by DOT employees continue to utilize staff time for training. The staff time required by the DOT varies based on the number of citizen reporters signing up.

- Once the citizen reporting program is in place the **annual cost to operate and maintain the system is minimal** ranging from \$5,000 to \$13,000 per year.
- **Citizen reports are typically received in winter months and during commute periods** which has increased road coverage in ITD, MnDOT, UDOT, and WYDOT as well as timeliness of reports to the public.
- **Many states do not archive citizen reports** and are unable to track the number of reports or content of reports received.
- **Citizen reporting programs have provided an opportunity to work together with the public with the potential to increase safety.**

5.0 CITIZEN REPORTING: STATE DOT DATA SHARING WITH WAZE

Up-to-date roadway and traffic information is important for DOTs when making traffic management decisions. Waze, a crowdsourcing navigation application that uses a complex algorithm and the real-time speeds of its users to determine the best driving routes, is becoming an information source that motorists are increasingly turning to for driving and route guidance. DOTs are exploring and many are using Waze information to supplement road condition information on their travel information websites.

Waze

Waze is a free, community-based traffic and GPS-based navigation app that enlists users to report on traffic, road hazards, road conditions, and weather using their smartphone. Users type in their destination address and drive with the app open on their phone to passively contribute to traffic and other road data by allowing Waze access to their location and determine their speed. Users may also take a more active role by sharing road reports including accidents, hazards, and road closures to provide other users with this information. User volunteers are awarded points and levels based on their Waze experience and reporting history. Higher levels indicate more Waze experience and greater reliability, allowing users increased access to edit or update data. Waze also has an active community of online map editors that ensure data is as up-to-date as possible.

Waze also connects users to create local driving communities and provides turn-by-turn voice directions automatically rerouting motorists as conditions change on the roads. Waze relies on users to provide real-time traffic and road information to update its maps. A group of online map editors ensure map data in their areas is up-to-date by utilizing user data to update the Waze map which evolves with each new data point provided.

Waze was initially launched in 2008 in Israel as a social navigation tool. In 2013, Google purchased Waze and now acquires 70% of its traffic data for its Google maps from Waze. Currently, Waze is supported in 27 different languages in 57 countries.

Connected Citizen's Program

The Waze Connected Citizens Program (CCP) is a global initiative to facilitate a two-way traffic-related data exchange between Waze and its traffic collection partners. These partners include government agencies and private road owners and operators who are approved through the CCP.

Waze government partners share information such as road closure, constructions projects and incident data with Waze. Government partners will receive real-time publicly-available closure and incident data including accidents, traffic jams, and hazards from Waze drivers as well as estimated travel times.

Currently, to be accepted into the Waze Connected Citizens Program, a partner must be a government agency or private road operator, complete the CCP membership application, execute Google's Traffic Data Cross-License Terms and Conditions (or Google's CCP contract), and possess real-time traffic-related data with the right to provide that data to Google.

Waze Summits are held semi-annually for CCP partners and include user presentations about how the partners are integrating Waze into their systems. The fourth international Waze Summit that was held in 2016 identified 75 Waze CCP partners.

Source: [Waze](#)

The following sections document the experiences and lessons learned of several DOTs that are accomplishing citizen reporting through CCP agreements with Waze. Phone interviews were held with the Kentucky Transportation Cabinet (KTC), Iowa DOT (IDOT), and Oregon DOT (ODOT). In addition, an online search was conducted to document agency experiences with Waze data.

5.1 Kentucky Transportation Cabinet

KTC signed a CCP partnership agreement with Waze in October 2014. Kentucky initially began using the Waze data to create internal email alerts. This allowed staff to see where issues were being reported and to use additional sources of information to verify and address these issues. The email alert process continues to evolve to communicate real-time road conditions internally.

Filtering Waze Data

Kentucky uses the Waze reliability rating to filter Waze reports. Waze rates its users on a scale of 0-6 and increases their rating level based on their reporting experience and the number of Waze users who verify their reports. This creates a Waze reliability rating of 0-10. Kentucky considers Waze reports with a Waze reliability rating greater than 5. This reduces the number of reports they review while allowing them to access the most accurate data.

Throughout the state, KTC may receive 1,500-2,000 email alerts from Waze on a weekend. District 5 (metro) may receive several hundred reports daily but other parts of Kentucky have a much smaller Waze user base and KTC may receive few email alerts with a reliability rating greater than 5 for eastern and western Kentucky. Since Waze data is refreshed every 15 minutes it may take a long time to increase the reliability rating in these parts of Kentucky to something greater than 5. Therefore, KTC is considering adjusting their process to apply a lower reliability rating for eastern and western Kentucky since fewer reports and fewer Waze users generate less opportunity to verify each report. Waze data with a slightly lower reliability rating is still preferable to delayed information or no information. For example, in areas with fewer Waze users it could take an hour to reach a reliability level greater than 5. Kentucky is now investigating incident reports when they reach a level 5. Level 5 incident reports are now grabbed and time stamped with the first report so they know how long the data has been active.

Waze Data Uses

Typically, the maintenance cost for a winter for KTC is \$40-45 million. During the winter of 2014-2015 KTC incurred approximately \$78 million in winter maintenance costs. During March of this winter, Kentucky experienced a snow storm that started with heavy rainfall moving west to east. A sudden cold snap dropped temperatures 30° in less than an hour. Waze reports progressed from rain to flooding then to freezing rain and ice and finally to heavy snow. KTC was able to use multiple Waze reports to verify their own traffic data and dispatch trucks more quickly in an attempt to stay within the 20-minute delay to report incidents to the public guideline as specified by the [23 CFR 511 - Real-Time Management Information Program](#).

Kentucky is devoting some effort to interpreting crowdsourcing data. In September 2015, more than 6,400 unique Waze reports were made on Waze for I-75, however, Kentucky's 511 site only identified 29 incidents. Anecdotal feedback from KTC suggested that the correct number was most likely somewhere in between these two extremes, therefore Kentucky is trying to consolidate and summarize Waze reports based on traffic data to supplement the 511 data. Kentucky uses multiple sources to allow them to identify and disregard erroneous reports.

Each Waze report has a unique ID. In the past Kentucky would edit the report record as new information was discovered but then data was lost and the age of the report was difficult to determine. Now, a snapshot of each report is taken and stored to allow KTC to identify how quickly reports are agreed upon and the duration of time before reports are reviewed and acted upon.

DOT Employees as Waze Reporters

Waze is allowing states to use government IDs to make Waze reports. Kentucky is encouraging employees to make Waze reports as a government issued report. This type of reporting provides information to Waze but also helps KTC by providing reliable, authoritative information. When information is listed on Waze as a government issued report, Kentucky may be more apt to use it to facilitate maintenance. For example, when missing signs are reported to Waze by private citizens, KTC waits for verification and may not immediately act on replacing the sign, but if the missing sign reports are government issued, KTC checks cameras and plans to identify what signs should be in the area so they have the right sign on the maintenance truck the next time it is in the area.

Integrating Multiple Data Sources

KTC uses real-time information from sensors, data providers, and partners throughout the state. They make use of duplicate data sources to assemble a comprehensive picture of what is happening on Kentucky roadways. Crowdsourcing data such as Waze and HERE is used in conjunction with air and road temperature data, traffic cameras, and KTC construction and roadway information. HERE collects real-time data and updates every 60 seconds from over 100 reliable sources to anticipate future traffic conditions by analyzing over one trillion GPS data points and factoring in real-time traffic and historical data as well as other considerations such as seasonality. In addition to satellite data and GPS data points, HERE uses information collected from a fleet of HERE True vehicles, multiple local field offices, and a variety of devices across the globe including smart phones, PNDs, sensors, connected cars, police radio messages, Twitter posts, and traffic camera feeds to deliver maps, data, and cloud-based innovative technologies and services that contribute to the design of intelligent mobility.

Kentucky is not trying to determine which data source is more reliable. Instead, Kentucky uses Waze and HERE data together to create a more comprehensive view of Kentucky's roadways. This approach is less expensive than developing a proprietary mobile app themselves. Kentucky also pulls in Twitter information and aggregates the real-time data.

When Kentucky's traffic data indicates a drop in speed, KTC can check Waze for an accident report. Then, after determining a beginning and ending mile point they consult HERE and can use HERE Jams data to build a roadway history. KTC summarizes the information and sends one internal email alert for the incident instead of multiple Waze reports for the section of road. By consulting the weather database for air and road temperatures and following links to maps and cameras at multiple sites, Kentucky can estimate a cause. The dashboard for consolidated roadway data is located at www.transportation.KY.gov/realtime.

5.2 Iowa Department of Transportation

Iowa DOT identified a need for additional automated data alerting staff of incidents instead of waiting for law enforcement calls. There were issues integrating data feeds from law enforcement due to data presented in a variety of different formats. Crowdsourcing was identified as the best solution to assist this issue and in early 2014 Iowa approached Waze for information to improve information on road conditions.

Filtering Waze Data

Iowa DOT receives many Waze reports. The large amount of Waze data that Iowa DOT receives requires them to find a way to narrow it down so that it is not redundant or overwhelming. Waze reports included on Iowa DOT's 511 traveler information map are filtered for events that affect traffic and are noted as Waze reports. Generally, Iowa DOT limits Waze reports to Iowa's interstates and state highways, filtering out Waze reports located in adjacent states. Since Iowa DOT already posts construction events on these roads, Waze reports of construction events are redundant and filtered out. In addition, vehicles stopped on shoulders or information on pothole locations as well as other non-traffic impacting events are filtered out and not included on Iowa 511.

Waze road closures are also filtered out because Waze treats roads as a set of distinct points and therefore identifies every intersection along a closure as a separate event. Consequently, a 2-mile road closure may generate 25 road closure events.

IDOT also filters Waze data in a variety of ways for internal use. The Waze data feed describes the location of events. This information is run through IDOT's linear reference system to identify the route and milepost which is then placed in the subject of email notifications. For example, motorist assist/highway helper is dispatched out of Cedar Rapids, Iowa City, Des Moines, and Council Bluffs. The GIS team has geo-fenced an area for highway helpers to get email notifications based on Waze data. The data is filtered for events that would be useful to the highway helpers such as vehicle stopped on the shoulder or debris on the roadway. This helps them not only know where assistance is needed but also what kind of a situation they are looking for.

Waze Data Uses

On Iowa 511, multiple Waze reports from multiple citizens often result in multiple notifications for the same event. These events are merged to prevent duplicates. In March 2016 there were 193 separate confirmed events from Waze notifications where the TMC had not been previously notified by law enforcement. The desire is to learn of, respond to, and communicate events to the public and first responders as quickly as possible without increasing the demands on law enforcement or DOT responders.

Performance Measures

Iowa DOT has recently added performance measures for Waze data. An example of information that is reviewed in performance measures is the number of confirmed Waze incidents compared to the number of Waze reports evaluated against TMC data. Monthly TMC reporting just began last fall and is still evolving. Iowa started archiving Waze data in November 2015. Iowa DOT archives the data through the state system.

Outreach and Feedback

To promote the partnership between Iowa DOT and Waze, a press release was created. This involved several iterations as Iowa DOT wanted to promote their partnership without directly advertising for Waze; however, Waze also needed to review the press release. Initially, after the press release of Iowa DOT's partnership with Waze in August 2015, Iowa DOT received a lot of public feedback. Since then most of the feedback has been internal.

5.3 Oregon Department of Transportation

ODOT identified a need to enhance information and provide more frequent reports to their traveler information website ([TripCheck](#)). ODOT joined the Waze CCP to provide additional roadway information to the information currently posted. In April 2016, ODOT began supplementing current road condition information provided by the DOT with Waze data. The partnership bypassed the process of ODOT building and maintaining an app for crowd sourced data collection in-house.

Filtering Waze Data

ODOT automatically filters the Waze reports to select the reports to be included in the ODOT's TripCheck Website. Filtered out data includes police activities, chat, cars stopped on shoulder, or reported closures. Waze data that is posted to ODOT's website has Waze user reliability rating of 5 or more on a 1-10 scale.

Waze Data Uses

Feedback from ODOT described a day in the month of July 2015 where there were 5,439 reported Waze events (1900 jams, 3415 weather, 6 closures, and 118 accidents).

The TripCheck Website displays Waze data on state, county and city roads, and is not limited to state operated highways. Waze events have a slightly different icon that DOT entered events. The mapping functions of the TripCheck Website enable ODOT to display Waze events on local roads. As TripCheck Website users click on an icon of an event that was received by ODOT from Waze, the event detail includes the statement "Data Provided by Waze" as shown in the figure below. Waze data is not turned on until zoom level 6 of their traveler information website.



Figure 8: Screenshot - ODOT TripCheck Website: Example Waze Event

ODOT has found that in some cases when a Waze user reports a crash, their location represents where they are in the traffic queue and not the location of the crash. However, in other cases Waze data provides an accurate location of the crash before ODOT has been able to publish their event.

ODOT has also routinely observed that the Waze reported delay information is very close to ODOT reported delay in areas ODOT has instrumentation. The data provided by Waze will be archived by ODOT and incorporated into their planning and analysis processes.

DOT Data

In order for Waze to generate a road closure for a section of road a beginning and end point is required. ODOT currently is unable to generate this data in their source system. However, ODOT is in the process of identifying predefined closures built as polylines to send to Waze when there is a road closure in order for Waze to post road closure information provided by ODOT.

Another item to note is that Waze receives data from ODOT as well as other sources. The fact that data from multiple sources are being merged together may provide duplicate reports of the same events in Waze.

5.4 Other Agencies

As noted earlier there are at least 75 CCP partners. These partners include government agencies and private road owners and operators who are approved through the Waze CCP. The following table includes additional examples of the two-way data sharing between Waze and a few of its partners.

Table 3: CCP Data Exchange Sharing Examples

Agency CCP Date	Data Exchange Sharing Examples
Florida DOT March 2014	<p>Florida DOT (FDOT) FDOT provides data such as road and lane closures to Waze to reach more motorists.</p> <p>Waze Data FDOT has developed a process for incorporating Waze data into SunGuide, FDOT’s statewide Advanced Traffic Management System (ATMS), integrating ITS devices and TMC operations. This is particularly important for arterial roads and non-instrumented sections of limited access highways where FDOT data collection was limited. Waze data is filtered by FDOT.</p> <ul style="list-style-type: none"> • FDOT filters out data that operations staff already had access to such as weather and data that is not transportation related (e.g. police locations, chit-chat). Information such as crashes, vehicles stopped on the shoulder, and debris is provided to operations staff for inclusion in the traveler information system. • FDOT filters data based on Waze user level and the type of information. For example, all crashes are reflected on FDOT’s site but by incorporating data reports from only users with a higher Waze level, the quantity of the data is decreased without diminishing the quality of the data. • Florida also filters Waze data by districts to prevent operations in any district from being overwhelmed with statewide data.

Source: [WAZE – FDOT Integration – ITS Canada Presentation \(1/2/16\)](#)

City of Boston February 2015	<p>City of Boston Boston will send road closure and construction information to Waze. The information will be incorporated into the Waze app to provide city information to Waze users.</p>
	<p>Waze Data Waze’s data will be shared with Boston’s Traffic Management Center (TMC) to help determine signal timing. Boston has 550 traffic signals that can be controlled from Boston’s Traffic Management Center and can use Waze’s real-time data to change those traffic signals as needed to improve traffic flow. This information then alters the suggested routes sent to Waze users and reduces commute times.</p>
	<p>Boston is considering future innovative uses of Waze data to implement and measure congestion management including giving buses priority through traffic lights to decrease bus commute times and encourage ridership which would then reduce vehicle traffic.</p>

Source: [Wired.com – Boston is Partnering with Waze to make its Road Less of a Nightmare](#)

Pennsylvania Turnpike Commission May 2015	<p>Pennsylvania Turnpike Commission (PTC) - http://fox43.com/2015/05/08/pa-turnpike-partnering-with-navigation-app-waze/ Waze will receive live feeds from the Pennsylvania Turnpike’s Traffic Operations Center (TOC) including traffic incidents, road closures, construction alerts, and estimated travel times.</p>
	<p>Waze Data PTC will receive Waze’s publicly available incident and road closure reports to improve the accuracy, timeliness, and availability of roadway information and allow TOC to use one of their 50 cameras to see real-time updates and share information with drivers. TOC dispatchers will receive notification of crashes faster which will improve incident response time. In addition, maintenance crews will become aware of vehicles on the shoulder, debris on the roadway, and potholes sooner.</p>

Source: [Pa. Turnpike partnering with navigation app Waze](#)

City of Louisville September 2015	<p>City of Louisville Louisville sends a data feed of its road closure and construction information to Waze.</p>
	<p>Waze Data Waze crowdsourcing reports are communicated to the City of Louisville to improve internal operations such as decreasing the response time to address crashes, managing congestion, or removing road hazards. Louisville receives a data stream from Waze that includes user data without the user identification. This data allows the Louisville Metro Government to use Waze data for historical data analysis projects including congestion mapping, corridor safety, and incident confirmation.</p>

Source: [Louisville Metro Government and Waze: Communicating Road Closures to the public](#)

Nebraska Department of Roads March 2016	<p>Nebraska Department of Roads (NDOR) Waze will receive real-time government-reported construction, crash, and road closure information.</p> <p>The Department of Roads can provide Waze users, Wazers, advanced notice of major traffic events such as parades or dignitary visits that will affect daily routes and will measure and share their findings to help develop case studies that will define a global set of improvements.</p>
	<p>Waze Data NDOR will receive real-time incident and traffic information from Waze users.</p>

Source: [Nebraska Department of Road Joins Waze Connected Citizens Program](#)

Tennessee DOT March 2016	<p>Tennessee DOT (TDOT) TDOT will provide Waze with information on statewide road conditions, closures, and traffic.</p>
	<p>Waze Data Waze is providing real-time road activity to TDOT. Waze information is placed on a level of TDOT’s SmartWay app to give motorists the ability to change their routes, adjust their commute times, and avoid unnecessary delays.</p>

Source: [TDOT Joins Waze Connected Citizen Program](#)

Caltrans April 2016	<p>Caltrans Waze will receive Caltrans’ road condition reporting data, construction updates, and road closure information to share with its users.</p>
	<p>Waze Data Waze will provide Caltrans with real-time travel information on California’s roadways.</p> <p>Waze reports indicated a high numbers of active users even before the Caltrans partnership was finalized including over 1.7 million active users in Los Angeles and more than 678,000 active users in San Francisco. These users have contributed more than 2.5 million alerts in Los Angeles and nearly 970,000 alerts in San Francisco each month.</p>

Source: [Caltrans Partners with Waze Connected Citizens Program](#)

5.5 Summary of Key Findings and Lessons Learned

The following bullets highlight key findings and lessons learned from the sections above of agencies that utilize Waze data to supplement road condition information on their travel information websites.

- The ***Waze Connected Citizen’s Program is still a new program***. DOTs began signing agreements with Waze in 2014. However, the program as of 2016 had at least 75 agencies participating. Since these partnerships are new, the agencies are still learning how to best utilize Waze data for their needs.
- ***Data provided by Waze create a lot of reports***. For example, in Oregon on a day in July 2015 there were 5,439 reported Waze events (1900 jams, 3415 weather, 6 closures, and 118 accidents). ***Each state filters the data before it is posted to the state DOT traveler information website***. Information typically filtered out includes: police activities, chit chat, and cars stopped on shoulders. DOTs also filter out road closure reports. Instead of indicating a continuous route for a road closure, Waze views roads as a set of distinct points therefore identifies every intersection along a closure as a separate event. Consequently, a 2-mile road closure may generate 25 road closure events. DOTs also filter out any Waze reports that have a less than 5 Waze reliability rating on a 1-10 scale.
- ***State DOTs use Waze data in a variety of ways***. Waze reports may alert a DOT of an incident sooner than law enforcement is able to notify the DOT of an incident. For example, in March 2016, ***IDOT received 193 separate confirmed event notifications from Waze describing events that the TMC had not been previously notified by law enforcement***.
- ***Waze is allowing states to create and use government IDs to make Waze reports***. When information is listed on a Waze report as a government ID, it allows the DOT to recognize that the report was received from a DOT staff employee.
- ***Typically, DOTs use a different icon style or identify that the data source is Waze to provide consumers of the information with notice that the report was received from Waze***.

6.0 CONCLUSIONS

This section provides an overall conclusion of the information gathered of states that operate and maintain a citizen reporting program and states that utilize Waze data to enhance road reporting.

- **Citizen reporting** whether developed in house by a DOT or by a data sharing agreement with Waze is a relatively **new approach for DOTs**. The exception to this is WYDOT that developed a program in-house over 10 years ago.
- **Data provided by Waze creates a lot of reports** and DOTs need to filter out much of the data. Data provided by **in-house citizen reporters does not require a lot of filtering**. This is due to training conducted by the agencies with reporters on what type of information to report.
- **Both approaches for citizen reporting have increased road condition reports and therefore increased travel information available to the travelers.**
- Feedback from DOTs describe success stories where **Waze reports inform DOTs about the incidents prior to law enforcement reports of the same incident.**
- **In-house citizen reports are typically received in winter months and during commute periods** since these programs are focused on providing winter road conditions. **Reports from Waze are received year round** since Waze reporters provide reports on more than just road conditions.
- **Many states operating an in-house citizen reporting program do not archive reports.**
- Some states that operate an in-house citizen reporting program enter reports as DOT reports. However, some DOTs differentiate citizen reports when displaying the conditions to the public. Typically, **Waze reports are differentiated from DOT reports when displayed to the public.**

Citizen reporting programs, whether state DOT operated or through agreements with Waze, have both provided DOTs with an approach to increase the frequency and increase the coverage of road reporting.