Sample Crowdsourcing for Operations Applications

The table lists and briefly describes a sample of the varied applications of crowdsourcing to improve transportation systems management and operations. Focus applications include the following:

- Traveler information.
- Incident management.
- Arterial traffic management.
- Freeway traffic management.
- Road weather management.
- Work zone management.
- Performance monitoring and reporting.
- Maintenance.

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Application Area	What (Application)	Who (Organization)	Where (Location)	Data Source	Brief Description/Benefits
Traveler Information	Travel Times on DMS Dynamic Message Signs (DMS) Statewide	Arizona Department of Transportation (ADOT)	Statewide	INRIX	After converting over from using loop detector data to using speed probe data to provide travel times on DMS in the Phoenix metropolitan area, ADOT is moving to a statewide system so that all DMS will have two destinations with travel times that are updated every 5 minutes. ADOT also uses the Dangerous Slowdowns (DSD) feature under the INRIX safety alerts umbrella to be automatically notified of these types of events.
Traveler Information	Mobile app based 511 information	Delaware Department of Transportation (DelDOT)	Statewide	Waze, Citizen Reports	DelDOT provides a free mobile app that includes a suite of 511 services. Users can use the "Report an Issue" feature to report specific roadway issues (e.g., traffic, potholes, debris, pavement conditions, etc.) and can see information on Waze incidents and traffic slow-downs. Without the use of crowdsourced data, it would not be feasible to provide real-time updates for many of the 511 services.
Traveler Information	Online and phone-based 511 information	Georgia Department of Transportation (GDOT)	Statewide	Waze	GDOT partnered with Waze to support the 511 traveler information system. Through this partnership, Waze events have been integrated into GDOT's web-based traffic map.
Traveler Information	Online 511 information	Iowa Department of Transportation (IDOT)	Statewide	Waze	IDOT adds Waze events to the 511 traveler information system. Users of the system can select a "Waze events" layer to view reported Waze data directly from the Iowa DOT website.
Traveler Information	Online 511 information	Metropolitan Transportation Commission (MTC)	San Francisco	Waze	The MTC provides live traffic monitoring, trip planning, and other 511 services on its website "511.org." By using crowdsourced data, MTC can cover a wider area and provide updates more rapidly to these services.
Traveler Information	511 and DMS travel time posts	Michigan Department of Transportation (MDOT)	Statewide	INRIX, Waze	MDOT uses INRIX data, aggregated every minute, at the traffic operations centers (TOC) to feed the speed layers of the 511 website, "Mi Drive," and to post travel times on DMS. Items viewed in Mi Drive can be shared by users on social media platforms such as Twitter and Facebook.

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Traveler Information	Navigation information	North Carolina Department of Transportation (NCDOT)	Statewide	Navigation Companies	NCDOT is committed to developing and maintaining positive working relationships with navigation companies, including Apple, Google, Waze, Bing, and TomTom. Through these efforts, NCDOT has developed a matrix of contacts at the various navigation companies when issues arise.
Traveler Information	Online 511 information	Oregon Department of Transportation (ODOT)	Statewide	Waze, HERE, ESRI	HERE provides ODOT with near real-time traffic congestion information. ODOT provides this information as a layer on the TripCheck website so travelers can see how traffic is flowing anywhere in the State, along with the associated delays.
Traveler Information	Online 511 information	Pennsylvania Department of Transportation (PennDOT)	Statewide	Waze, INRIX	PennDOT uses crowdsourced sources to populate its 511 information website "511PA." This data also powers a new trapped-traveler emergency communications tool, "511PA Connect," which allows incident response teams to communicate via automated phone or text message directly with motorists who are trapped in a roadway back-up. Crowdsourced data improves the speed, coverage, and reliability of both data products.
Traveler Information	Mobile app based 511 information	Virginia Department of Transportation (VDOT)	Statewide	Waze, Google	VDOT launched its next generation 511 traveler information app. The app provides users with real-time, accurate traffic information about road conditions, congestion, and highway work zones in Virginia. It includes push notifications and alerts, transit and parking information, travel times for driving and transit options, and turn-by-turn navigation. It combines official information from VDOT, driving and transit directions from Google, navigation with Waze, and other sources of information and uses Waze's "Deep Links" application program interface (API) to power the navigation feature.

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Traveler Information	Condition reporting mobile application	Wyoming Department of Transportation (WYDOT)	Statewide	In-house mobile app	WYDOT developed a hands-free mobile app for reporting conditions on- and off-highways statewide. The app allows citizens and DOT users to submit text and images, which are geo-located and directed to the TOC for vetting. Once verified, the information is automatically pushed back to app users as well as the 511 website.
Incident Management	Incident detection	Connecticut Department of Transportation (CTDOT)	Statewide	Waze, HERE, CT Travel Smart	CTDOT utilizes crowdsourced data for rapid detection of new potential incidents, thereby improving response times. Newly reported events from Waze are first verified with roadside cameras then entered into CTDOT's CRESCENT traffic incident management system using pre-populated fields. Where camera coverage is unavailable, Highway Operations Center (HOC) operators may call the Connecticut State Police (CSP) directly or reference CAD data for verification. This streamlined verification process further supports a rapid response.
Incident Management	Incident detection, data integration and analysis	Florida Department of Transportation (FDOT)	Statewide	Waze	FDOT combines Waze data with computer aided dispatch (CAD) system data to improve the response times for crashes and unplanned road closures. Data collected from Waze is imported directly into FDOT's advanced traffic management system (ATMS) system where it is integrated with CAD incident reports for analysis.
Incident Management	Incident detection	Iowa Department of Transportation (IDOT)	Statewide	Waze, INRIX	Waze and INRIX data are received by traffic management centers (TMC) for detecting incidents on rural roads where traditional detection coverage is sparse. In addition to expanding coverage, incidents were identified 9.8 minutes faster on average using crowdsourced data as compared to traditional methods.
Incident Management	Incident detection, data integration and filtering	Kentucky Transportation Cabinet (KYTC)	Statewide	Waze, HERE	Given high frequencies of Waze reports, KYTC developed an automated process to filter data and only send alerts to TMCs once certain reliability and speed thresholds are met. Information is also automated to generate an "After Action Dashboard" report. This dashboard combines traffic speeds and Waze incident reports in the same graph to provide a holistic understanding of the impact of incidents at a glance.

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Incident Management	Incident detection, data integration and filtering	Maine Department of Transportation (MaineDOT)	Statewide	Waze	Maine DOT feeds Waze data every three minutes into their COMPASS ATMS database. The data is viewable through an ArcGIS interface with live events visible. Events can be filtered based on spatial or data constraints defined by the operator.
Incident Management	Responder Safety	Missouri Department of Transportation (MODOT)	Statewide	Waze	MODOT is partnering with two commercial technology providers that have systems integrated with Service Patrol truck emergency lighting that inform Waze when those response vehicles are responding or stopped at incidents.
Incident Management	Incident planning, prediction, response, and proactive avoidance	Nevada Department of Transportation (NDOT) and Nevada Highway Patrol (NHP)	Statewide	Waze	Working with Waycare, a machine learning algorithm was developed that uses crowdsourced Waze data to predict traffic incidents. Using this analysis, proactive measures can be implemented to prevent traffic incidents in high-risk areas. This data-driven process has reduced traffic incidents by 17% along a section of the I-15 facility in Las Vegas.
Incident Management	Incident prediction and detection	Pennsylvania Turnpike (PA Turnpike)	Statewide	Waze, INRIX	The PA Turnpike uses Waze speed, alerts, and weather data in an Early Warning Detection Tool. Half-mile segments of roadways are scored based on inputs and TMC operators can concentrate camera tours and other monitoring on specific segments.
Incident Management	Queue Protection	Tennessee Department of Transportation (TDOT)	Statewide	Waze	TDOT partnered with the University of Tennessee to use real-time Waze data to estimate the end of traffic queues at traffic incidents. This will target response personnel and advance warning systems to warn approaching motorists about upcoming slow moving or stopped traffic ahead.
Incident Management	Traffic incident prediction	United States Department of Transportation (USDOT)	Maryland Statewide	Waze	The USDOT's Volpe Center trained a machine learning model that can predict future incidents based on Waze crowdsourced data. This allows problem areas and high-risk events to be swiftly identified and responded to.

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Arterial Traffic Management	Prioritize Corridors for Signal Retiming	City of Austin	Austin	INRIX	Given camera coverage at only 18% of intersections, the City of Austin had difficulty maintaining and expanding sensors to gather useful traffic data. By purchasing crowdsourced data, they were able to implement a data-driven signal retiming strategy rather than a cyclical one. This approach has enabled the agency to more efficiently allocate resources and improve regional throughput.
Arterial Traffic Management	Monitor Arterial Performance for Signal Retiming	District of Columbia Department of Transportation (DDOT)	Washing-ton, DC	Waze	DDOT incorporates crowdsourced data into a dashboard that monitors minute-by-minute arterial performance. This reporting is then used to make more effective decisions on proactive signal retiming than would be possible without such data.
Arterial Traffic Management	Traffic prediction and infrastructure planning	Five municipal counties in Lake Tahoe area	Lake Tahoe	AirSage	Several agencies that manage roads in and around Lake Tahoe used anonymized cell phone data from AirSage to identify traffic patterns and congestion areas. This analysis enabled better infrastructure planning and traffic management strategies for improved traffic flow.
Arterial Traffic Management	Assess Signal Timing Changes	Louisville Metro	Louisville	Waze	Louisville Metro applied Microsoft Power BI to its archive of Waze data to rapidly assess signal timing changes. This application enables a more robust, lower cost, and quicker assessment compared to traditional manual methods such as floating car studies.
Freeway Traffic Management	End of queue and incident detection	Indiana Department of Transportation (INDOT)	Statewide	INRIX	INDOT uses crowdsourced data to predict where slowdowns in traffic are most likely to become dangerous. They have created a tool to identify when speeds change significantly, as well as the length of queues, which allows them to alert drivers and take other proactive measures to reduce end-of-queue rear-end collisions.
Freeway Traffic Management	Regional systems operations	Port Authority of New York & New Jersey (PANYNJ)	LaGuardia Airport	Waze	PANYNJ uses detailed crowdsourced data to accurately measure airport travel times. The use of this data enables specific travel-time reducing changes such as directing for-hire vehicle (FHV) traffic to Terminal B after 10:00 pm.

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Road Weather Management	Snow and ice management	Kentucky Transportation Cabinet (KYTC)	Statewide	Waze, HERE, CoCoRahs	Using a big data architecture and tools, KYTC combines crowdsourced data with internal data and third-party data sets to better manage and report the treatment of roadways under snow and ice conditions. All incoming data is shared in consolidated work layers – one of the layers is the Roadway Weather Layer. KYTC publishes all data to a map to display weather, traffic, construction, and Waze information, and they have developed several associated dashboards and decision support tools that are shared with agencies statewide.
Road Weather Management	Road condition updates in extreme weather conditions	South Carolina Department of Transportation (SCDOT)	Statewide	Waze, ESRI	During Hurricane Florence, SCDOT used Waze data to update weather-related road conditions. This data was bolstered by 350 volunteer map editors that were dedicated solely to hurricane related road updates. SCDOT used this data to identify flooded roads and to update public road condition information far more quickly than it might have otherwise.
Road Weather Management	Citizen Reporter Program	Utah Department of Transportation (UDOT)	Statewide	In-house mobile app	The UDOT Citizen Reporter Program provides a consistent way for volunteers to report weather and road conditions (including incidents) to UDOT. Unique to this program is the training that citizen reporters receive and an automated tool to balance citizen reports with meteorological data. This program created over 5,200 reports during the 2018-2019 winter season, and sampling of the crowdsourced data has found it to be over 95% accurate.
Work Zone Management	Detour management	Indiana Department of Transportation (INDOT)	Statewide	INRIX	Using INRIX data, INDOT can analyze the best available detour routes to ensure optimal traffic flow. One such incident involved a month long 37-mile road closure along I-65, during which a 62-mile detour route was monitored and operational strategies deployed using this data.
Work Zone Management	Work zone monitoring	Kentucky Transportation Cabinet (KYTC)	Statewide	Waze and HERE	KYTC uses crowdsourced data for work zone monitoring. By blending crowdsourced and traditional data, KYTC can create more detailed reporting both for its own use and for sharing via its online traveler information system. KYTC has developed several detailed work zone monitoring maps and dashboards for internal use by TOC operators, construction safety officers, and planners.

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Work Zone Management	Detour management	Port Authority of New York & New Jersey (PANYNJ)	NY/NJ Region	Waze	PANYNJ pushes work zone information to Waze and other platforms to ensure travelers do not attempt unsafe movements and to reduce traffic in areas of work zones. When a new exit to LaGuardia airport from the adjacent freeway opened, push notifications were sent to over 140,000 targeted Waze users. For another roadway change, a Waze "hazard" was added for drivers nearing the site. Users signaled their appreciation for this information, including more than 1,000 thumbs up.
Performance Monitoring and Reporting	Road performance dashboard reporting	Indiana Department of Transportation (INDOT)	Statewide	Waze, HERE	INDOT collects raw data on vehicle speeds from crowdsourced global positioning systems (GPS) services. This raw data is then processed to support a dozen mobility dashboards that report congestion profiles, travel delays, and speed maps for road segments. These dashboards support a variety of analysis including ranking road segments by performance.
Maintenance	Pavement Repair	Delaware Department of Transportation (DelDOT)	Statewide	DelDOT App and Waze	DelDOT has created a single app for traveler information and event reporting. Travelers submit reports through the app and can also report events through Waze. The agency collects and geolocates the reports and shares relevant reports with each district weekly to inform plans for repair of potholes or other issues.
Maintenance	Potholes	Illinois Tollway	Tollway Roads	Waze, Integrated CAD, IPASS,	The Illinois Tollway uses Waze data to improve timeliness of pothole detection and a value add for incident detection given they have integrated CAD within their ATMS system. The Waze data increased event counts between 15% - 25%. The Tollway filters data for major events, stalled vehicles, debris, and potholes.