Tech Brief

U.S. Department of Transportation
Federal Highway Administration

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E-TICKETING

The sixth round of the Every Day Counts (EDC-6) initiative selected electronic ticketing (e-Ticketing) for rapid deployment among highway agencies to enhance work zone safety, improve quality, and realize cost savings through digitalization.

Highway construction projects generate massive amounts of valuable data that historically were communicated via paper. Paper tickets to track the delivery of materials at a construction site is one such source of data. The emergence of electronic technologies on highway construction projects has made the paper-based processes outdated, inefficient, and cumbersome. Highway agencies are integrating paper processes into electronic and digital workflows. Earlier rounds of EDC successfully promoted the deployment of e-Construction technologies.

E-Ticketing is a market-ready digital innovation that automates the recording and transfer of information and quantities in real-time, in lieu of paper tickets, as materials are moved from the plant to the site. E-Ticketing simplifies handling and integration of materials data into information systems for acceptance, payment, and source documentation. The overarching goal of the EDC-6 initiative is to facilitate the adoption of e-Ticketing by state and local highway agencies.

FHWA initiated peer-to-peer exchanges to deliver technical assistance to highway agencies exploring to implement e-Ticketing. The peer-to-peer exchanges provide opportunities for an exploring agency to learn from the experience of states that have successfully adopted e-Ticketing. The peer-to-peer exchanges facilitate interactions among participating agencies to share effective practices and address challenges and barriers relating to e-Ticketing implementation. The discussions focus on various critical success factors, including a business case, planning for pilots, field readiness, stakeholder engagement, data management, and specifications. The peer-to-peer exchange facilitates dialogue with stakeholders and decision-makers on the next steps of implementation.

WASHINGTON DEPARTMENT OF TRANSPORTATION E-TICKETING PEER EXCHANGE

EDC-6 PEER-TO-PEER EXCHANGES

INTRODUCTION

Washington Department of Transportation (WSDOT) has long recognized the need for a contactless solution to address the safety hazards of ticket takers collecting weigh slips from delivery trucks. Owing to the need for contactless delivery during the COVID-19 pandemic (2019 to 2022), WSDOT issued a construction bulletin that allows contractors to use any electronic format—such as images of paper tickets, portable document format (PDF), and e-Tickets—for delivery tickets. Since then, WSDOT has been accepting tickets in electronic formats that are not digitalized for further manipulation by information systems.

To date, WSDOT has depended on the contractors' fleet management solution to access and collect e-Tickets. The agency solicited feedback through a questionnaire survey from the agency personnel, contractors, and material producers about their experiences with using e-Ticketing solutions. The survey elicited mixed responses with both positives and improvement opportunities on the agency's processes.

WSDOT is planning to procure a Web portal solution for e-Ticketing that would receive tickets electronically from any pre-authorized contractors and material producers regardless of their business size, share of DOT work, or the fleet management solutions they use. Furthermore, over the last four years, WSDOT has been successfully implementing numerous applications in the Oracle® Unifier™ cloud-based enterprise platform to automate business processes across various phases of a project's lifecycle.

As WSDOT seeks to deploy the e-Ticketing portal solution for bituminous, ready-mix concrete and aggregates, the agency intends to achieve a goal of "collect once, use many times." To implement e-Ticketing successfully, WSDOT consulted state DOTs that have successfully adopted e-Ticketing through a peer-to-peer exchange.

The Federal Highway Administration (FHWA) sponsored a day-and-a-half-long peer-to-peer exchange in Vancouver, Washington, on January 24 and 25, 2023. The meeting included an FHWA representative; representatives from DOTs who had successfully implemented e-Ticketing (i.e., the lead agencies)—Delaware (DelDOT), Georgia (GDOT), Iowa (IOWADOT),and Pennsylvania (PennDOT); two subject matter experts from the EDC contractor's team; and participants from WSDOT and the local construction industry. WSDOT hosted the event and provided meeting room facilities. The meeting included a combination of presentations, panel discussions, questions and answers, and a participant survey.

SUMMARY OF LEAD AGENCY PRACTICES

IOWADOT's Practice

IOWADOT conducted its first e-Ticketing pilot in 2015 with asphalt mixtures and its first concrete pilot in 2017. Since then, IOWADOT has scaled up significantly to complete hundreds of e-Ticketing projects with asphalt, aggregates, and concrete. To date, IOWADOT has completed more than 300 e-Ticketing pilots and plans another 200 construction projects in 2023.

IOWADOT's practice has evolved significantly. In the earlier phase of e-Ticketing, IOWADOT depended on fleet management products to access e-Tickets. Recognizing the challenges with handling multiple products, IOWADOT decided to move away from installing multiple vendor applications to a single application on the field inspectors' mobile devices. IOWADOT deployed a commercially available off-the-shelf (COTS) web portal on a pilot basis that receives e-Ticketing data from authenticated suppliers via a JavaScript Object Notation application programming interface (API). To date, 25 vendors are connected to the portal. The portal is connected with all major suppliers via APIs and with small suppliers via direct connections.

Building on piloting experience, IOWADOT is seeking to deploy an advanced version of the e-Ticketing portal. IOWADOT has released a Request for Proposals (RFP) soliciting the development of vendor-based solutions for an e-Ticket handling system for its next phase in December 2022. IOWADOT anticipates deploying its next-generation portal in the summer 2023. IOWADOT has developed business and technical requirements that entail but are not limited to archiving, data analytics, document management, integration with applications, technical and user documentation, and performance and security enhancements. The next-generation portal implementation will also enable automatic data exchanges between the portal's cloud and IOWADOT's information systems and other applications. IOWADOT also envisions a two-way API-based communication to share construction test data from the e-Ticketing portal with contractors.

IOWADOT has updated DS-15095—the developmental specification for e-Ticketing—and intends to include e-Ticketing in the standard specifications. In response to data-related challenges, IOWADOT is planning changes to data processes, including standardizing ticket data with set definitions for data attributes and creating the data sharing rules. IOWADOT is also testing technology-driven alternatives to meet on-site internet connectivity needs using cellular signal boosters and to verify truck delivery using cameras. IOWADOT has been communicating its successes by speaking to the industry, understanding stakeholder needs in the field, providing support, and investigating long-term uses of e-Ticketing data.

DelDOT's Practice

DelDOT originally planned to conduct a pilot in 2017, but it did not happen because of funding related challenges. After a three-year wait, DelDOT renewed the e-Ticketing implementation planning and completed the first set of pilots on asphalt paving projects in summer 2021. DelDOT adopted a COTS web application to receive tickets electronically from material producers. DelDOT connected many asphalt producers to the web application by 2021 and made e-Ticketing a requirement on all asphalt paving projects in spring 2022. The agency has also been steadily expanding e-Ticketing to concrete, soils, and aggregates.

Since the onset of e-Ticketing implementation planning, DelDOT has decided not to make the Global Positioning System (GPS) truck location data a requirement for e-Ticketing. The agency was interested only in receiving the ticket data electronically without any consideration to the fleet management solutions that the contractors and material producers use. DelDOT engaged both internal and external stakeholders. The DelDOT e-Ticketing team conducted ad hoc meetings with the leadership. DelDOT also held bi-monthly meetings with the Delaware Contractor's Association and ad hoc meetings with the Delaware Asphalt Pavement Association. By 2022, DelDOT had completed 32 projects and had collected over 20,000 tickets for asphalt mix delivery. DelDOT rolled out an automated workflow for payment processing using digitalized tickets in Oracle® Primavera Unifier™, the agency's cloud-based enterprise platform for construction management (DelDOT, 2022).

PennDOT's Practice

PennDOT conducted its first e-Ticketing pilot in 2017. The first phase of pilots included approximately four projects (only in District 11) until March 2020. Since then, PennDOT has expanded e-Ticketing to all districts. To date, PennDOT has completed more than 140 projects and received 70,000 tickets. The first phase of e-Ticketing pilots required submitting GPS truck location data. Following the six-week shutdown of construction operations caused by the COVID-19 pandemic, PennDOT conducted an assessment on how e-Ticketing can be leveraged to assist with contactless management. The agency solicited feedback from various stakeholders (from material producers to field

inspectors) about their concerns. Because almost three-fourths of the field inspectors are hired consultants, PennDOT established an industry working group with the Pennsylvania Turnpike Authority and industry associations. The lessons learned from the earlier pilots led to key changes, such as removing the GPS requirement and re-writing specifications.

PennDOT's e-Ticketing web application—which was developed to accept e-Tickets via an API and to make them available to inspectors in the field through mobile applications—went live on July 1, 2021. PennDOT also created three teams (a specification team, an IT team, and a hauling team) to assist with implementation. PennDOT allows the contractors to price their e-Ticketing expenses using a lump-sum bit item to incentivize them. As the e-Ticketing program expanded, the bid prices rapidly came down to as low as $1.00. PennDOT plans to make it incidental to the material delivered in 2024.

PennDOT, learning from earlier pilots, identified the following key critical success factors: finding internal champions, identifying projects with high chances of success, selecting the right material type of interests, specification changes, leveraging preconstruction meetings, deciding information required on tickets, and training. PennDOT noted that the persisting challenge was getting suppliers with limited department work and limited network connectivity on board. The agency has been working with district materials engineers to contact suppliers and elicit their feedback on implementation barriers.

GDOT's Practice

GDOT conducted its first pilot in October 2019 and expanded the pilots to at least one project in each district. In consultation with the Georgia Highway Contractors Association, GDOT developed a construction specification for the pilots. GDOT used a lump-sum bid item for its pilots to allow contractors to expense their costs for providing e-Ticketing services. The bids ranged from $1 to $10,000. The pilots, which were completed by summer 2020, provided an opportunity to draw lessons learned before a statewide rollout. In October 2020, GDOT informed the construction industry about its plan to roll out e-Ticketing on all bituminous projects beginning April 2021. GDOT plans to expand e-Ticketing to ready-mix concrete and aggregates.

Unlike other leading agencies, GDOT uses approved fleet management solutions (in lieu of a web portal) to access and collect e-Tickets. The agency has approved four vendor products and is approving a fifth product. The contractors have the flexibility to select any of the pre-approved vendor products and to train their personnel accordingly. The contractors are required to submit individual truck tickets in PDFs and a summary of deliveries in both PDF and Excel formats. In the event of internet outages or absence of connectivity, the contractors should have offline capabilities on their vendor solutions. The contractors upload these records to the agency's ProjectWise system. GDOT does not use a centralized database; therefore, it stores and archives by delivery date and material type. The data is manually entered into the AASHTOWare® Project for payment processing.

WSDOT's E-CONSTRUCTION PRACTICE

WSDOT deployed its first e-Construction technology in 2013 with the rollout of a mobile-based technology solution Headlight® for field inspection. WSDOT also embarked on modernizing its information systems by implementing Oracle Unifier. The Unifier system went live in April 2020 with an initial pilot deployment that included one construction project office from each of its six regions.

WSDOT has created a roadmap for Unifier implementation with a development and deployment schedule of numerous applications. WSDOT initially began with implementing daily reports, creating business processes for submittals and transmittals, and deploying them for projects. In 2021, WSDOT migrated Unifier and Primavera v6 to Oracle's cloud services. By 2024, the agency plans to integrate e-Ticketing, e-bidding, and materials testing related systems with Unifier.

The agency opted for Unifier as the project lifecycle management solution to provide governance across all project phases. Unifier supports the project lifecycle needs of the agency that include general documentation and workflow management, capital planning, project delivery, cost control management and forecasting, facilities and real estate management, operations and maintenance, and dashboards and reporting.

WSDOT selected Unifier because of its numerous advantages: the ability to automate business processes with turnkey solutions, the ease of customizing applications, access to system upgrades with advancements, and lower programming requirements. Unifier serves 1,572 WSDOT and external end-users. To date, WSDOT has completed 219 projects and handled approximately 40,000 records in the Unifier environment.

SUMMARY OF IMPORTANT ISSUES AND KEY OBSERVATIONS

Implementation Planning

The implementation pathway entails two steps:

- Define the material types, technologies, vendors, procurement and pay methods, technology features, data considerations, control and verification, and internet connectivity.
- Consider the "Technology–People–Process" aspects of e-Ticketing:
  - Technology: Review the technology barriers, like mobile devices, internet connectivity, e-Construction platforms, and information systems. Determine the type of tickets. Assess how the tickets will be collected, tracked, stored, and used. Deployment of an enterprise solution requires a structured planning, from business requirements analysis to rollout and change management.
  - People: Secure both internal and external stakeholder buy-in for e-Ticketing implementation. Conduct training to field inspectors before the pilots begin.
  - Process: Review the current process with paper tickets and accordingly devise a process of getting the information electronically.

The key implementation considerations are engagement with external and internal stakeholders, procurement, contract administration, and paying for e-Ticketing.

Paying for e-Ticketing

FHWA indicated that both e-Ticketing and enabling internet connectivity at the construction site are eligible expenses for reimbursement under the federal-aid highway program. FHWA discussed several existing FHWA grant programs for WSDOT to fund pilot initiatives, including the State Transportation Innovation Council, the Accelerated Innovation Deployment Demonstration Program, the Accelerating Market Readiness program, and the Infrastructure Investment and Jobs Act (FHWA, 2022).

Field Readiness

The peer exchange event discussed the following factors related to field readiness for e-Ticketing:

- Mobile Devices – GDOT has equipped its inspectors with Apple iPhones and tablet devices. The agency is transitioning toward the use of laptops and Microsoft tablets/surface. IOWADOT uses iPhone SEs or iPads with cellular connection and a flip phone. WSDOT has rolled out iPads and laptops to field inspectors; however, they have challenges in integrating iPads with Unifier. DelDOT, who also uses iPads and Unifier, had the same challenges. WSDOT has been working with Oracle to address these challenges. The inspectors frequently face lower battery life, sun glare, and overheating challenges with their mobile devices. The lead agencies also acknowledged the common issues with mobile devices and shared workarounds. The lead adopters use battery packs as supplementary power sources to help inspectors use the devices throughout the day. The DOTs have established a plan for systematic replacement of mobile devices. Mobile devices have a lifecycle of three to five years. DelDOT uses devices until they are broken, but plans to implement a three- to five-year replacement cycle. Based on manufacturer software and security update practices, PennDOT has forecast that devices would last for four years.
- Use of Multiple Devices – Though dependent on pre-approved fleet management solutions, GDOT has had no issues with field inspectors handling multiple products.
- Cellular Coverage – The DOTs typically have selected project locations with good internet connectivity for their pilots. While internet coverage has improved throughout the state, dead zones still exist and are most prevalent in plants and quarry pits in remote locations. The DOTs have also been testing alternatives in areas with no or intermittent cellular coverage. Many agencies requires an offline mode on mobile applications that inspectors can rely on in areas with intermittent cellular coverage. The e-Tickets synchronize later when the device connects to the internet. The offline mode in e-Ticketing mobile applications is effective in locations with spotty or intermittent loss in coverage. The offline mode is not effective in dead zones. Other alternatives include the use of cellular signal boosters, quick response (QR) codes, and low-earth orbit satellite internet. IOWADOT purchased cellular signal boosters using State Transportation Innovation Council funds and anticipates deploying them in future construction seasons. IOWADOT also identifies project locations with weaker cellular signals and notifies cellular service providers in Iowa for further mitigation.
- Connecting Small Suppliers – The lead adopters are successfully addressing the challenges of small suppliers by connecting them directly to their

e-Ticketing portals. These agencies offer vendor services, at no cost to small suppliers, to connect a database system from their plants to the web portal to enable direct transmittal of tickets.

Specification and Data Requirements

WSDOT Specification: WSDOT has developed two documents for e-Ticketing: Construction Bulletin #2021-01 *Electronic Ticketing System* (which has been archived), and Section 1-09.2 Weighing Equipment of the *Standard Specifications for Road, Bridge, and Municipal Construction*. The agency also requires the contractors to submit the Daily Summary Report for each day's hauling operations and Certificate of Compliance for concrete delivery. The specification requires the following data fields on the e-Tickets: date of haul; contract number; contract unit bid item; unit of measure; identification number of hauling vehicles; and gross and net weights of materials delivered. The e-Tickets should also include a running total of quantities delivered to the project on a given date. WSDOT does not require paper tickets. The contractors have the flexibility to use the fleet management solution of their choice; however, WSDOT requires the contractors to submit a contingency plan to address challenges with lost internet connectivity. The contractors are also required to provide on-site training and technical assistance during the initial setup for both the contractors and WSDOT staff. The specification describes the requirements for batching scales, platform scales, and belt conveyor scales, including verification protocols.

Many examples are available for WSDOT to consider. In particular, the lead adopters (such as PennDOT and IOWADOT) have updated specifications as their practices have evolved. American Association of State Highway and Transportation Officials (AASHTO) Material Delivery Management System (MDMS) is an approved national standard that WSDOT could use. The key requirements of a good e-Ticketing specification are related to the systems that suppliers can use, data attributes that a DOT requires, internet connectivity at the job site, how a DOT will pay for e-Ticketing, and validation of the information on the e-Ticket.

The DOTs referenced in this document have specific clauses on e-Ticketing system requirements in their specifications. These clauses describe the DOTs' requirements on approval and testing of e-Ticketing solutions, ticket latency, file formats, preconstruction meeting, system outage, and training and vendor support. Most agencies have dropped the GPS requirement in their specifications. The DOTs have additional clauses—such as switching to offline mode, requiring paper tickets, or developing alternative means for enabling connectivity—to handle loss of internet connectivity. The basis of payment for e-Ticketing could be a lump-sum bid item or be incidental to the material that is delivered.

IOWADOT Specification: IOWADOT has been using development specification DS-15091, *Developmental Specifications for Electronic Ticketing* for e-Ticketing (IOWADOT, 2021). The developmental specification focuses on the material of interest, lists the required data attributes by material type, and describes the rules for transferring information. IOWADOT's specification requires a 5-minute latency for delivery, considering the time an API requires to receive a ticket, and delivers the tickets in batches. When developing a specification, an agency should consider ticket handling during erratic internet connectivity, instructions for contractors, and the importance of consistent project numbering.

IOWADOT's Camera-Based Verification: To create verification approaches, a DOT could consider the requirements for paper tickets (such as weigh-scale certification and on-site verification) and how other technologies (such as cameras, applications, and GPS) can be leveraged to assist with verification. To date, field inspectors have been performing visual verification to ensure that the vehicle (for which a ticket has been issued) delivers the material to a job site. Because this process is inefficient, IOWADOT has been conducting pilots on camera-based, electronic proof of delivery. Camera-based verification is an alternative to GPS-based proof of delivery.

Cameras are installed at the plant and on material transfer vehicles or pavers at the job site. Cameras are automatically triggered to capture the license plates of the trucks at the plant and at the job site. This technology verifies that a truck with a specific ticket has left the plant, when it gets to the job site, and when the truck dumps the material into a material transfer vehicle or paver. The cameras capture visual proof of delivery of a truck and the cycle times of a truck. The technology drops both latitude-longitude data with cellular connectivity and time stamps. However, IOWADOT noted that applying this technology for concrete and aggregates would be challenging because there is no single dump location.

PennDOT Specification: PennDOT has also developed e-Ticketing specifications for bituminous, aggregates, and concrete. The specification describes the data fields required on the ticket. The agency requires only the minimal details of information on the ticket. The tickets can be delivered in a CSV (comma separate values) or Excel file to PennDOT. The contractors have the

flexibility to use a fleet management solution of choice, but are required to submit details of their proposed system to the agency for approval at least 30 days in advance. PennDOT is also investigating the use of different technologies, such as magnet codes and license plates, to aid with truck identification in the field.

Material Delivery Management System: Minnesota DOT (MnDOT) led the development of MDMS, an AASHTO provisional specification, to manage data associated with the delivery of material to a contract (AASHTO, 2022). Serving as a standard and industry best practice, MDMS presents a library of data attributes that allow agencies to select elements that work best for the agency. MDMS covers data attributes for e-Tickets; loading and delivery events; hauler; testing and contract administration; and independent field verification. The current version of the MDMS includes material-specific data attributes for asphalt, aggregates, concrete paving, and ready-mix concrete. AASHTO has successfully balloted MDMS and approved it for publication.

Federal-Aid Requirements

Source documents record the quantities of completed work and form the basis for approving partial payments to contractors. Federal regulations do not specify what the source document is, but DOTs need to determine the source document based on their payments system and their recordkeeping methods in coordination with their FHWA Division Office. Before e-Ticketing was introduced, paper tickets served as source documents, but image-based replicas, such as photographs and scans, did not. FHWA considers e-Tickets to be source documents because the tickets are created electronically with the information, and transmitted, stored, and manipulated in an electronic environment, creating a chain of custody events and alterations. FHWA enumerated various laws, statues, and memoranda relating to source documentation and records retention. This information is codified at 23 Code of Federal Regulations (CFR) § 635.123 and 2 CFR § 200.334 (CFR 2013a, CFR 2013b).

Web Portals and Data Management

IOWADOT's Portal: The agency is piloting a COTS web portal. The e-Ticket data received through the portal is hosted in a cloud. In the future, e-Tickets will be integrated with DocExpress® and AASHTOWare® Project, and will be overlaid on a geographic information system (GIS) application. However, in the interim, IOWADOT has developed a temporary solution using Microsoft® Excel to summarize and use e-Tickets. The Excel solution captures the ticket data from contractor-supplied files in PDF or CSV format and summarizes all data attributes on e-Tickets. IOWADOT also exports e-Ticketing to OnStation, a digital stationing application that allows users to pinpoint the exact location using station coordinates where each load of asphalt is placed on a jobsite. The agency also exports e-Ticketing to a proprietary GIS for further applications. IOWADOT is procuring a web portal through an RFP process.

PennDOT's Portal: The agency has deployed User Acceptance Testing, an API-based web application developed in-house, for the e-Ticketing portal (PennDOT, n.d.). The User Acceptance Testing receives tickets electronically from pre-authorized suppliers through an API, which are then posted on a Microsoft Azure portal. The e-Ticketing data feeds into the applications automatically to assist inspectors in simplifying data entry. To date, PennDOT has four vendors connected to its system for asphalt and aggregates and three vendors in progress for asphalt, aggregates, and concretes, and is planning to include additional vendors. Using the mobile application developed for e-Ticketing, PennDOT inspectors can access, accept, reject, or void the tickets and add comments.

Since 2013, PennDOT has been developing mobile applications in-house as a part of its digitization goal. The agency involves eight iOS programmers in application development. With every application, PennDOT re-engineers the business process with online data transfer to legacy systems, improved data quality, build user-friendly interfaces, reduced data entry, and offline work capabilities.

PennDOT's e-Construction initiative also involves many enterprise systems and applications, including Engineering and Construction Management System (ECMS), Construction Documentation System, PennDOT Project Collaboration Center, Electronic Construction and Materials Management System (eCAMMS), and Mobile Construction. The agency has been linking several of its legacy and new systems. PennDOT is working on integrating e-Ticketing data with ECMS and eCAMMS systems.

DelDOT's Portal: DelDOT has deployed an API-based COTS product for an e-Ticketing web portal. An authorized supplier, who received an authentication key from DelDOT, can send tickets electronically (in the JavaScript Object Notation file format) through the API. The web application is connected with a cloud through Dell® Boomi™, which connects with on-premises applications and data (Dell, 2023). Both field inspectors and contractor personnel can access data on the vendor's cloud through an application on their mobile devices. This mobile application is housed on Apple's

App Store and is available to be installed on any iPhone or iPad. The inspectors can see the ticket in a mobile application and can accept, reject, or void the tickets and add comments.

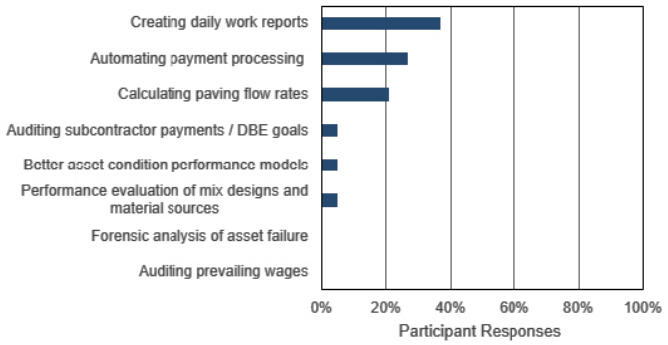
With more than 160,000 Inspector Daily Reports created since 2017, DelDOT also uses Oracle® Unifier to manage the construction program. DelDOT has also used Unifier to enable business processes for contractor payments and change orders. This business process gathers delivered tickets, checks for split tickets, prepares ticket packages, and creates summaries of batch tickets by pay items and non-pay items along with their corresponding quantities for payment processing. Future planned activities include receiving automatic yield checks that use pavement data captured by pavers and appending quality test results with ticket data.

Data Management and Use: The peer exchange event captured the participants' perspectives on handling data-management issues:

- As a contingency measure during unanticipated internet outage, the DOTs make use of offline capabilities in their mobile applications. The DOTs also change to paper tickets and reconcile with e-Tickets later. In many states, the suppliers continue to print paper tickets to satisfy law enforcement requirements.
- When a ticket is modified, most e-Ticketing solutions create an audit trail to record the changes to the ticket. An agency may allow changes to a ticket within a specific period on a case-by-case basis upon request from the supplier.
- The portals may perform automatic validation of the data upon receipt. However, the agencies prefer to validate only the format of field values, such as data type and field length, but not the reported values, such as quantities, themselves. Nevertheless, the format issues with data fields generally decrease over time.

The real-time survey, conducted at the peer exchange, captured the participants' priorities of use cases where the e-Ticketing data can be used (see Figure 1). The participants preferred to use e-Ticketing to create daily summary reports, automate payment processing, and calculate paving flow rates.

Figure 1. Participants' rankings of e-Ticketing use cases



STAKEHOLDER ENGAGEMENT

Stakeholder Outreach and Feedback

The success of any pilot or enterprise implementation is contingent on all stakeholders being engaged, and communicating benefits and addressing the challenges. To that end, WSDOT has been working with the industry associations, including the Washington Asphalt Association, and Washington Aggregate and Concrete Association. WSDOT continues to work with these industry associations through joint committees, bi-annual meetings with construction and material devices, and newsletters. Through these engagements, WSDOT seeks to leverage these associations to communicate its implementation goals and secure their buy-in. WSDOT also conducts outreach with its internal stakeholders, including the Project Engineer's Offices in each of the six regions, to ensure that their needs are also met.

The industry-at-large is receptive to WSDOT's implementation efforts. Partnerships forged with WSDOT and the industry associations played a critical role in securing their support for e-Ticketing implementation. WSDOT communicated regularly with the industry about upcoming changes. If necessary, the industry was open to forming a joint subcommittee to support implementation or to discuss with WSDOT directly. Supportive of maintaining an open conversation, the industry preferred ample time to allow for going through the implementation process.

IOWADOT shared its experience with stakeholder coordination. As a part of the implementation process, IOWADOT has been working with stakeholders such as the Associated General Contractors of Iowa, the Asphalt Paving Association of Iowa, the Iowa Ready Mixed Concrete Association, the Iowa Concrete Paving Association, and the Iowa Limestone Producers Association. IOWADOT outlined three steps to stakeholder coordination: (i) working with the contractor

to discuss and find solutions; (ii) allowing suppliers to select solutions that suits their business practices; and (iii) allowing adequate time for adoption. The DOTs referenced in this report should consider helping small contractors and suppliers with their implementation.

Leveraging joint events and preconstruction meetings, IOWADOT continues to explain the agency's vision for e-Ticketing and therefore alleviating skepticism and addressing problems. Training has been a significant part of stakeholder engagement. IOWADOT has a dedicated person providing online and in-person training, and telephone and email support. PennDOT trains its personnel during off-season. The lead adopters have made various resources—such as construction manual Wiki, on-demand videos, Frequently Asked Questions, and quick reference guides—available for training.

The real-time survey captured how WSDOT and contractor participants perceived potential challenges of implementation (see Figures 2 and 3).

Figure 2. DOT Participants' Ranking of Implementation Challenges

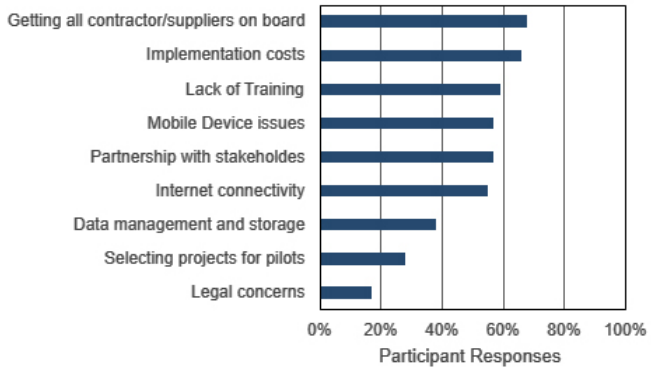
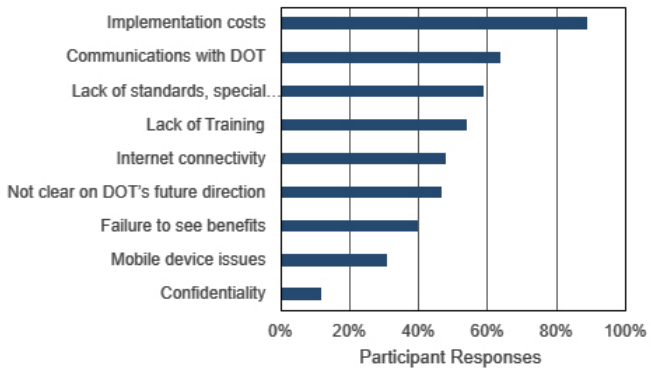


Figure 3. Private Industry Participants' Ranking of Implementation Challenges



For both WSDOT and private sector, high implementation cost is one of the top challenges for e-Ticketing implementation. WSDOT identified that getting all contractors and suppliers on board would be a challenge, while the contractors emphasized the need for robust communication with WSDOT. The importance of training was also emphasized. Other challenges included lack of cellular coverage, issues with mobile devices, and lack of guidance on operating procedures.

ROADMAP DEVELOPMENT

WSDOT leveraged the peer-to-peer exchange event to further discuss the key implementation elements and to solicit stakeholder feedback.

WSDOT has been accepting e-Tickets in the last few years and seeks to institutionalize the practice of e-Ticketing in the future. WSDOT envisions an e-Ticketing practice that focuses on worker safety, untaps process efficiencies such as "collect once and use many" for data, and adopts an inclusive solution. To achieve this vision, the agency anticipates adopting an incremental and systematic approach to e-Ticketing implementation.

WSDOT identified the following as the principal tasks of implementation to move forward: establish data requirements; review and update the specification; coordinate with stakeholders; identify goals for pilots; select pilot projects; conduct training; and incorporate data. In the near term, WSDOT plans to procure a portal system, deploy it in pilots, and test the portal functionalities and business processes. WSDOT has initiated the procurement for an e-Ticketing portal. The agency is also considering an in-house development of the portal.

WSDOT considers e-Ticketing in the continuum of its recent multi-year efforts to standardize and streamline construction administration processes in the Oracle Unifier environment. The tickets received by a web portal will be exported to Unifier to support the automation of business processes, including payment processing. Therefore, irrespective of the e-Ticketing portal solution selected for future use, WSDOT will reevaluate to ensure that the agency is getting the right data at the right time and is able to accept the data in the right spot.

WSDOT anticipates that an e-Ticketing portal will be ready for deployment in summer 2024 no matter whether a portal is a vendor or in-house product. Nevertheless, the agency intends to use the 2023 construction season to conduct a few e-Ticketing pilot projects. The agency would hand-select pilot projects that help achieve the goals of the pilot program. The agency will also solicit internal and external volunteers for the pilots. WSDOT is committed to maintaining communication and coordination with stakeholders. If needed, the agency might consider setting up a working group with industry stakeholders to discuss next implementation steps.

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DISTRIBUTION AND AVAILABILITY
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e-Ticketing, peer-to-peer

U.S. Department of Transportation
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WSDOT intends to deploy a system that works for everyone in metropolitan and rural areas, and that is consistent and auditable and has supplier acceptance. Recognizing the lack of internet connectivity in rural areas, the agency will investigate alternative solutions to address internet connectivity problems. WSDOT is also field-ready as the field inspectors are equipped with iPads with cellular connection, iPhones, and laptops. WSDOT will enable connectivity between the e-Ticketing solution and Oracle Unifier.

REFERENCES

American Association of State Highway and Transportation Officials (AASHTO). 2022. Standard Specification for Material Delivery Management Systems. Draft. Last Updated November 28, 2022. Under Publication.

Delaware Department of Transportation (DelDOT). 2022. Part F—eConstruction. Section F3.00—Unifier Documentation (web page). https://constructionmanual.deldot.gov/index.php/Part_F_-_eConstruction, accessed March 6, 2023.

Federal Highway Administration (FHWA). 2022. Center for Accelerating Innovation (webpage). https://www.fhwa.dot.gov/innovation, accessed March 6, 2023.

Iowa Department of Transportation (IowaDOT). 2021. Developmental Specifications For e-Ticketing. Ames, IA: Iowa Department of Transportation. https://iowadot.gov/specifications/dev_specs/2015/DS-15091.pdf, accessed March 6, 2023.

Pennsylvania Department of Transportation. n.d. eTicketing Web – UAT version 2.0. (webpage). https://mobilenprd.penndot.gov/eticketing_uat, last March 6, 2023.