Application Note

U.S. Department of Transportation
Federal Highway Administration

July 2023 FHWA-HIF-24-058

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 The emergence of electronic technologies on highway construction projects has made the paper-based processes outdated, inefficient, and cumbersome.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.

E-TICKETING IMPLEMENTATION FOR THE LUIS A. FERRÉ EXPRESSWAY (PR-52)

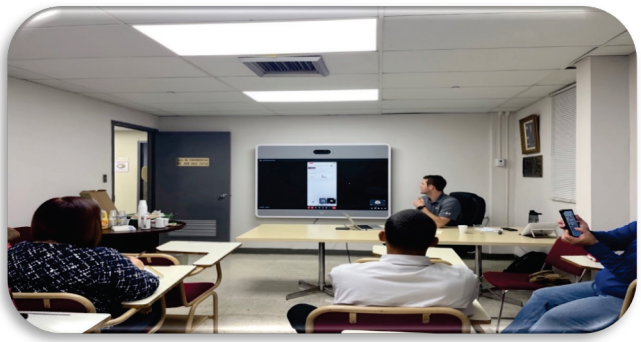
OVERVIEW

The Puerto Rico Highways and Transportation Authority (PRHTA) selected the e-Ticketing Innovation in Round 6 of the EDC Program to learn more about the benefits and how e-Ticketing is implemented in construction projects (FHWA, 2020). To champion e-Ticketing development, PRHTA appointed Eng. Ana L. Torres-Santana, PRHTA deputy executive director, and an implementation team that included the Associated General Contractors of America-Puerto Rico Chapter (AGC-PR), Puerto Rico Local Technical Assistance Program (Puerto Rico LTAP- T^2 Center), and Federal Highway Administration-Puerto Rico and USVI Division (FHWA-PRUSVI).

As part of the development phase of the EDC Program, the FHWA-PRUSVI sponsored a two-day peer exchange in San Juan, Puerto Rico. The meeting featured two FHWA representatives; technical staff from two Departments of Transportation that had successfully implemented e-Ticketing: Delaware (DelDOT) and Pennsylvania (PennDOT) (the lead agencies) (NCHRP, 2020); Lindy Paving, a Pennsylvania contractor with experience in electronic ticketing; two subject matter experts from the EDC contractor team; and participants from PRHTA, Puerto Rico LTAP-T^2 Center, and the local construction industry. The meeting included a mix of presentations, panel discussions, question and answer sessions, and a survey of participants.

Several vendors came to Puerto Rico to present their products to the peer-to-peer exchange. One provider, the HaulHub company, was interested in starting a demonstration project with PRHTA.

Figure 1. e-Ticketing Training in the PRHTA Regional Office in Ponce, Puerto Rico



Source: FHWA-Puerto Rico and USVI Division 2023

HaulHub is the developer of the **DOTslip e-Ticketing application (app)**, a tool that provides real-time access to ticket data across the territory for any asphalt, ready-mix concrete, or aggregates producer (HaulHub, 2023a). Communication began between the PRHTA and the supplier for the development of a demonstration project. Currently, the PRHTA is applying the HaulHub solution in a pavement rehabilitation project in the South Area of the Island. The results of the demonstration project will help the PRHTA to understand the feasibility of issuing electronic tickets in Puerto Rico.

In February 2023, the PRHTA and contractor staff received live training on how to use the Department of Transportation's (DOT) e-Ticketing app for asphalt activities (HaulHub, 2023a, 2023b). To facilitate the on-site implementation of this app, contractors, the PRHTA, and HaulHub coordinated. HaulHub's Director of Government Solutions directed the meeting, clarifying questions and giving program access to inspectors.

A plant inspector was at the Super Asphalt Plant (Asphalt Subcontractor), verifying each truck prior to its departure. Paper tickets and online tickets included asphalt temperature. Site personnel were aware of deliveries using the app, and as trucks arrived, each one was verified by the field inspectors, asphalt temperature was measured again, and after placing, the tickets were accepted online and on paper.

PRHTA and other representatives from the demonstration team had the support and technical assistance from HaulHub, Inc. the entire day. PRHTA inspectors used their own cellular devices during the e-Ticketing implementation.

This document provides important facts about the e-Ticketing implementation plan in Puerto Rico.

Figure 2. Members of Puerto Rico's Implementation Team for e-Ticketing

From left to right – Eng. Alejandro J. Abrams, Contractor; Eng. Andrés Álvarez, FHWA-PRUSVI; Dr. Benjamín Colucci, Puerto Rico LTAP-T² Center; Eng. Juan C. Rivera, FHWA-PRUSVI and Eng. Ana S. Jiménez, PRHTA

Source: FHWA-Puerto Rico and USVI Division 2023

PROJECT INFORMATION

Project Type, Location, Key Dates

- Project Name: Pavement Rehabilitation and Reconstruction, Luis A. Ferré Expressway (PR-52), Km 102.1 - 106.0, Ponce
- State No: AC-520146
- Federal Number: ZP-52(69)

Material Types

- Asphalt: WMA Superpave SPB

Contractor and Suppliers

- Main Contractor: Desarrolladora JA, Inc.
- Asphalt Subcontractor: Super Asphalt Pavement Corporation

Figure 3. Aerial image of the project, Luis A. Ferré Expressway (PR-52), Ponce, Puerto Rico

Source: Desarrolladora JA, Inc. 2023

IMPLEMENTATION PLANNING

Meetings and Technical Assistance

In November 2022, the PRHTA coordinated a meeting with the HaulHub provider, the contractor, Puerto Rico LTAP- T^2 Center, and FHWA-PRUSVI. At the meeting, the provider's representative presented the e-Ticketing app. Following this meeting, an action plan was prepared. The action plan included periodic meetings, asphalt subcontractor digital infrastructure evaluation, training, and deployment.

In February 2023, the vendor visited Puerto Rico to proceed with the field demonstration project. First, the vendor integrated the data from the asphalt plant with the e-Ticketing app. Then, they provided training to PRHTA and contractor personnel. During the presentation, the vendor introduced the full capabilities of the desktop and app versions to the participants. The vendor's representative answered questions and addressed doubts. The e-Ticketing app was field tested with a series of asphalt trucks coming from the asphalt plant to the project. At the project site, the vendor assisted both PRHTA and the contractor. Adequate internet connection, app comprehension, and the project staff's openness to innovation made the demonstration a complete success. Following the demonstration, a wrap-up meeting was scheduled to discuss the challenges and lessons learned from the demonstration.

Figure 4. Truck loading at the Super Asphalt Pavement Corporation Plant, Peñuelas, Puerto Rico

Source: PRHTA 2023

Figure 5. Placement of Asphalt Mix in PR-52, Ponce, Puerto Rico

Source: PRHTA 2023

Description

The implementation process began with integrating the selected ticketing data from the Super Asphalt Pavement Corporation plant via a secure application programming interface (API) to the PRHTA e-Ticketing portal. This enabled the plant to (1) generate e-Tickets automatically for each truck loaded at the plant and (2) transmit this data electronically to the e-Ticketing system. During the integration process, all data points that were previously collected on paper tickets were verified to be present on the e-tickets. This ensured that all necessary data were accurately captured and recorded on the new digital platform.

Figure 6. Super Asphalt Pavement Corporation Plant, Peñuelas, Puerto Rico

Source: HaulHub, Inc. 2023

Once the e-Ticket was generated, it was instantly available for all parties in the supply chain to see, including the asphalt Subcontractor (Super Asphalt Pavement Corporation), Contractor (Desarrolladora JA, Inc.), and PRHTA. This real-time visibility was made possible using two platforms within the e-Ticketing

system, one for the contractor and one for PRHTA. These platforms contained the same information but allowed both parties to interact with the data and keep their own notes.

To access the data, the PRHTA inspector and contractor foreman had the mobile apps on their phones. This allowed them to see the material tickets in real-time, acknowledge loads as delivered, and leave inspection details and photos on the job site. The PRHTA inspector at the plant also had the mobile app and was able to add his plant inspection temperatures and comments to the tickets before they left the plant. Once personnel completed these actions, the updates were available for all other participants on the web portal. All actions on tickets were logged in the audit log, so users could verify whether there were any questions about which inspector logged which comments.

Figure 7. DOTslip e-Ticketing in a Tablet

Source: FHWA-Puerto Rico and USVI Division 2023

Internet connectivity was not an issue at this site, as the plant had Wi-Fi and the job site had quality cell reception. However, the HaulHub platform does have an offline capability should cell service be an issue on a job site.

The data collected on the e-tickets included the same fields as those on the current paper material tickets, including supplier, job, product information, as well as the load's gross, tare, and net weights. The inspectors in the field and at the plant added user-input data points like temperature of material at plant, temperature of material at job site, delivery time, thickness, etc. These data points are stored on the cloud within the e-Ticketing portal and are accessible from any computer and can be exported in a.csv or.pdf format or tied into other e-construction tools.

The use of this technology will expedite the balancing and accounting process, whether by day, week, month, or year, and will avoid differences in quantities between the contractor and the inspection.

FIELD USE AND INSPECTION

Generation of Electronic Tickets

The information historically printed on the paper tickets that accompany loads of hot mix asphalt originates from a point-of-sale (POS) computer system housed at an individual asphalt plant or in a centralized location. As a load of mix is produced, the POS records the details electronically on a local database. With this information digitized, the producer can share the same information that was on a paper ticket in an electronic form.

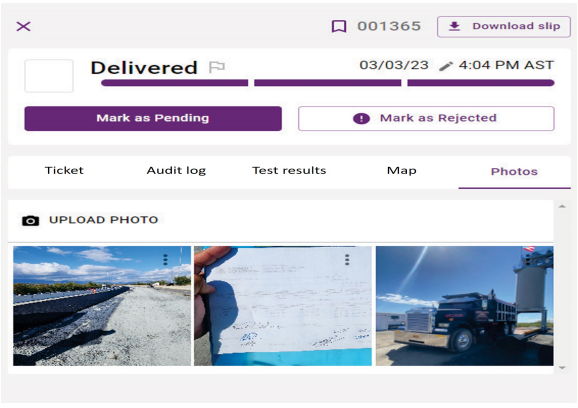
Transmittal of Tickets

Ticketing information consists of a lightweight data payload and transmits seamlessly, even in poor internet connectivity environments. The e-Ticketing information housed at an asphalt plant is sent to the field as the truck leaves the scale in near real-time via an internet connection at the plant.

Inspector's Receipt of Tickets

Field inspectors use the DOTslip e-Ticketing app to access real-time feeds of the materials information as loads leave the plant. Each project inspector has a unique login and various access levels are granted depending on role. For project administrators, multiple projects and the flow of materials across a region are visible. At the same time, project-based inspectors can accept and validate the materials coming onto their projects in real time.

Figure 8. DOTslip e-Ticketing Application for Mobile Devices



Source: HaulHub, Inc. 2023

Internet Coverage

The DOTslip application caches ticketing information on the inspector's smart device so he or she can interact with ticketing data even in an offline environment. The pictures, field notes, and quality control data that are captured in the field without internet connectivity will automatically sync to the correct ticket once internet access is restored. Should tickets go missing because of a plant outage or service interruption, inspectors can alert the project stakeholders in the app so that the root cause can be identified. When the system is back online, the missing tickets will be available for inspectors.

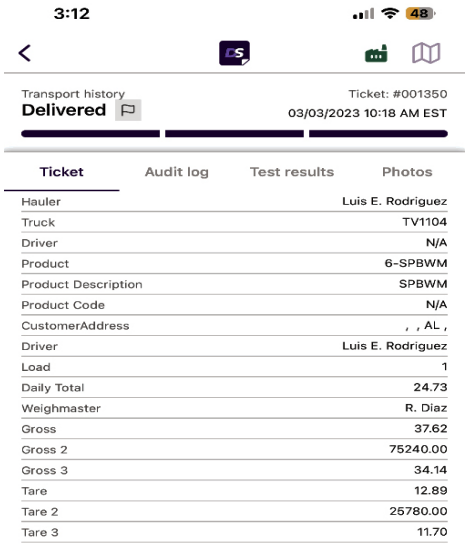
Mobile Devices

Inspectors can use any modern smart device to access the DOTslip app, which is available on both Android and iOS devices.

Verification

DOTslip includes a robust audit log to help users understand the flow of materials information across the supply chain. The app can capture information from the origination of the materials at the point of sale to the ultimate placement at the job site, creating a history of who has interacted with the ticket and added notes, pictures, or additional information. Once the material is at the site, an inspector can mark the load as delivered, and the app will collect geolocation information for enhanced verification of materials placement.

Figure 9. E-Ticketing Information on Inspectors Mobile Device



Source: HaulHub, Inc. 2023

DATA MANAGEMENT

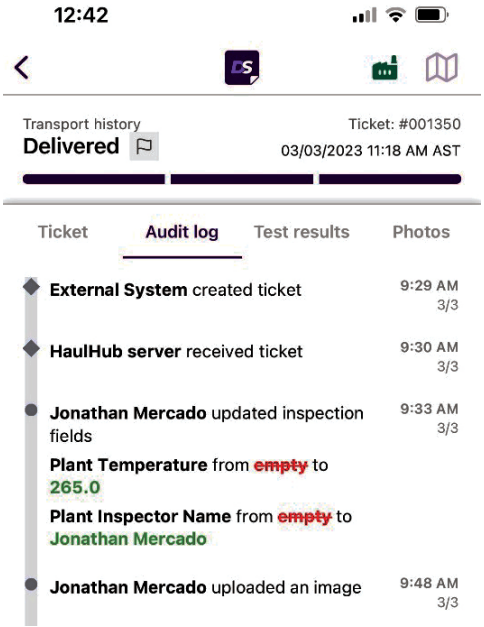
Data Attributes and File Format

Through a secure API, the e-Ticketing data from the asphalt plant transfers to PRHTA's e-Ticketing portal in real-time as the loads are delivered. The same information that was on the paper ticket is transmitted electronically to all project stakeholders.

Data Attributes:

- Created/Printed At
- Supplier
- Customer Name
- Contract #
- Job
- Job #
- Connected DOT Project Number
- Hauler
- Truck ID (i.e., license plate number)
- Driver
- Product
- Product Description
- Product Code
- Customer Address
- Load
- Daily Total
- Weighmaster

Figure 10. E-Ticket Audit Trail to Verify Ticket Chain of Custody



Source: HaulHub, Inc. 2023

Storage and Archival

The data reside in the PRHTA portal for use at any time by authorized users of the system. The data are saved and archived per PRHTA's record retention policies.

Construction/Document Management Systems

Because the information is consolidated and standardized in a uniform format, the ability to tie into other e-Construction systems across Puerto Rico is seamless. This ability can help facilitate more automated reporting, data capture, and payment reconciliation to accelerate payments to contractors.

The information saved and collected helps PRHTA in the daily production reports and give them a report for the proposed certification period.

Use of e-Ticketing Data

Information regarding trucks accepted at field, temperatures, notes, photos are stored in the app. After activities finish, information stored in the app is automatically sent via email to each person who had access to the program. Also, paper tickets are available at the field office.

ANTICIPATED BENEFITS, LESSONS LEARNED, STRENGTHS, AND CHALLENGES OF IMPLEMENTATION

State DOT Standpoint

PRHTA will benefit from the implementation of e-Ticketing to support the e-construction initiative. In the long term, this initiative will streamline field inspectors' reports. Some expected challenges are the acquisition, acceptance, and maintenance of adequate equipment needed for field inspectors as PRHTA moves toward full implementation. Resistance to change is always a possible challenge.

E-Ticketing apps show users the number of trucks that have departed from a plant, how many trucks been accepted at a site, and whether there are delays. E-Ticketing also summaries the quantity of asphalt placed at the project per day, making it an excellent resource for payment processing.

One of the challenges of HaulHub's e-Ticketing software is that information can be altered. After accepting all tickets for the asphalt placement, PRHTA encountered one ticket changed from the accepted status to the pending status. This was immediately corrected after consultation with HaulHub. The vendor verified, and apparently there was a problem synchronizing the information entered by the plant inspector and the field inspector. HaulHub was responsive and indicated that this issue wasn't very common.

Figure 11. Dr. Edwin González-Montalvo, PRHTA Executive Director *(Source: PRHTA 2022)*

"E-Ticketing is a cost-effective tool to safely expedite, collect and share relevant construction materials data to improve our contract administration processes. For PRHTA, it is a valuable technology that complements the E-construction innovation and other initiatives aimed at automating processes that will ultimately improve projects delivery". – Dr. Edwin González-Montalvo, PRHTA Executive Director

Contractor Standpoint

Major benefits from piloting/implementing e-Ticketing:

- Know in real time that the asphalt truck was loaded and dispatched from the plant.
- Know in advance the asphalt temperature when the truck was dispatched.
- Accelerates the process of balancing the amounts of asphalt deposited in the project by certification period.
- Know in real time where the asphalt was deposited (date, place, time, and photos).
- Know in real time when the inspector and the contractor sign the asphalt ticket.
- Have all the information related to each ticket at the end of day.

Major challenges from piloting/implementation:

- To have the information in real time it is necessary to have Internet service.
- Because the program is in English, users not fluent in English must be trained on the terms and meanings of the program.
- Signatures can be removed by any user of the program.
- In the contractor's platform, functions that are found in the DOT inspection app must be inserted, such as the option of photos and auditing.

Figure 12. Eng. Carlos Rodríguez, AGC-PR President
(Source: AGC-PR 2023)

"The Association of General Contractors of Puerto Rico values the e-Ticketing technology as an effective tool in asphalt production and construction projects by collecting and sharing data in the asphalt plant and the project, facilitating the contract administration process between the owner and the contractor in data collection uniformity, acceptance and payment of truck asphalt delivery and enhancing the overall safety at the plant and the project." – Eng. Carlos Rodríguez, AGC-PR President

FUTURE OF E-TICKETING

E-Ticketing in PRHTA's projects will provide all stakeholders with an electronic materials data that enhances safety, streamlines inspections, and improves contract administration processing. PRHTA is willing to continue deploying this innovation in future projects.

Several recommendations were identified in the field and will be provided to the selected alternative to improve the overall process:

- Include an electronic signature section in the app for the PRHTA inspector in the plant.
- Verify whether all information is accessible from any operating system on the device (i.e., iOS, Android).

As part of the e-Ticketing initiative, PRHTA must contemplate that the selected alternative can be integrated with the digital project management system, Project Management Information System (PMIS)-Unifier™, through APIs, with the objective of storing the information in the single project repository platform and for possible future uses in payment certifications, generation of statistics and/or analysis of used materials (Oracle, 2023).

The PRHTA will continue with demonstration projects, incorporating ready-mix material soon. Next steps for the implementation plan include the development of an e-Ticketing construction specification to be included in future projects. The PRHTA, in conjunction with the private sector, Puerto Rico LTAP-T^2 Center, and FHWA-PRUSVI, will discuss important issues in a future implementation of the initiative, such as general industry acceptance, the procurement process, and training.

Figure 13. Attendees of the e-Ticketing peer exchange in June 2022

Source: Puerto Rico LTAP-T^2 Center 20

JULY 2023

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NOTICE

NON-BINDING CONTENTS

QUALITY ASSURANCE STATEMENT

U.S. Department of Transportation
Federal Highway Administration

REFERENCES

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Figure 14. e-Ticketing process applied to the design, delivery, and compaction of Warm Mix Asphalt in Puerto Rico

Source: Upper left photo: FHWA-Puerto Rico and USVI Division; Upper right photo: HaulHub, Inc.; and Bottom photo: PRHTA 2023