

FHWA EDC-3/4 e-Construction & EDC-6 e-Ticketing

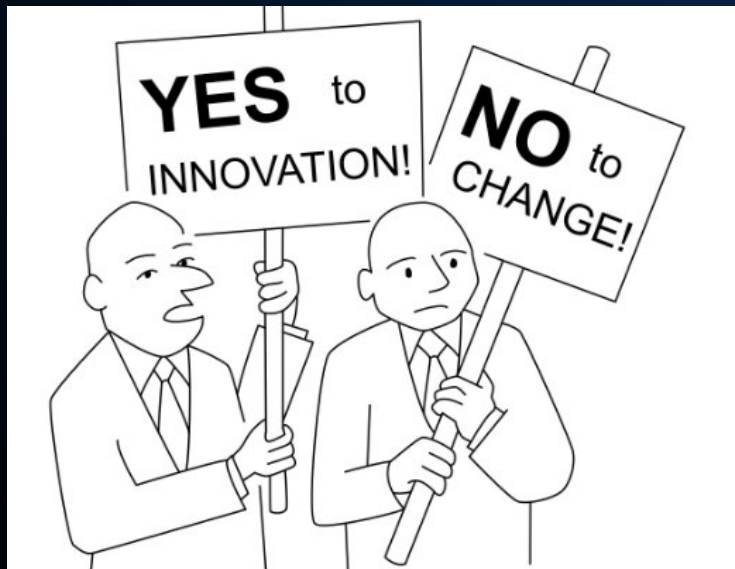
Kathryn Weisner PE, NRAEMT



Technology is nothing.

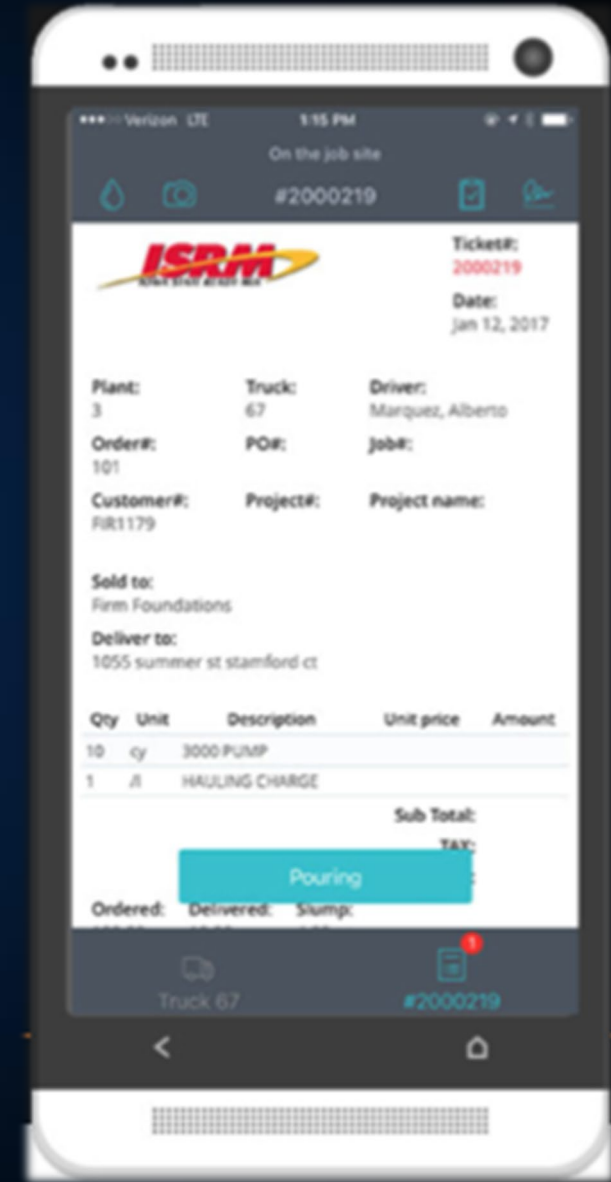
*What's important is that you have a **faith in people**, that they're basically good and smart, and if you give them tools, they'll do wonderful things with them.*

-Steve Jobs



Notice

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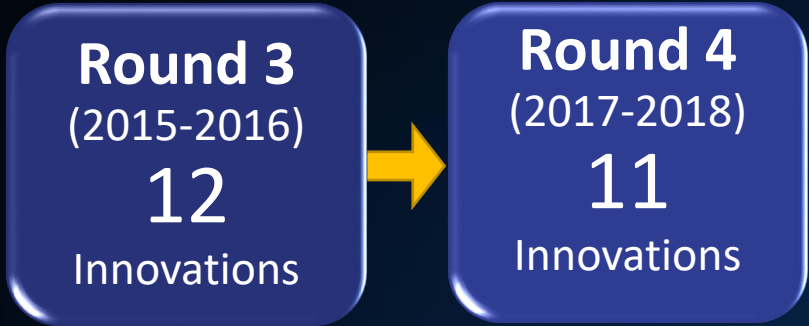
A **State-based model** that identifies & rapidly deploys
proven, yet underutilized innovations...

*...to shorten the project delivery process,
enhance roadway safety,
reduce traffic congestion, and
integrate automation (FAST Act §1444)*

Market-Ready, Proven...Underutilized

- ✓ Every State advanced 19 or more of the 52 innovations promoted in the first five EDC rounds, and some states adopted 40 or more innovations





- **e-Construction** an EDC-3 & EDC-4 innovation
 - ✓ 46 “states” Advanced to the Institutionalized, Assessment or Demo Phase

- **e-Ticketing** is an EDC-6 innovation
 - ✓ 48 of 54 “states” have a goal to advance **e-Ticketing** by December 2022, the highest acceptance rate in EDC history!
 - ✓ Development
 - ✓ Demonstration
 - ✓ Assessment
 - ✓ Institutionalization

Federal Technical Support

- 15 Peer Exchanges
- 4 webinars
- 1 National Workshop
- 1 Virtual Vender Showcase
- Update online e-C Matrices (by state & by Innovation)
 - <https://www.fhwa.dot.gov/construction/econstruction/peer.cfm>
- Technical Customer Support Hotline
 - FAQ posted on e-C Website
- TFHRC research project, e-Ticketing Part #2



Federal Financial Assistance



- Fosters & supports the **State Transportation Innovation Councils'** national network, \$100/STIC/year
 - <https://www.fhwa.dot.gov/innovation/stic/>



- Supports innovation thru the **Accelerated Innovation Deployment** grant program, up to \$1M per project
 - <https://www.fhwa.dot.gov/innovation/grants/>



- **Accelerating Market Readiness** supports emerging transformative innovations in safety, project delivery, and infrastructure performance

The logo for the Infrastructure Investment and Jobs Act (IIJA) features the acronym "IIJA" in large, bold, purple letters, centered within a white ribbon-like banner with green outlines.

- **SPR funds & Increased Federal Share**



Source: FHWA



U.S. Department of Transportation
Federal Highway Administration

Keep Informed

Sign up for EDC News and Innovator



Get on your mobile device! Text "FHWA Innovation" to 468311

<https://www.fhwa.dot.gov/innovation/>

What is e-Construction?



<<< From this ...

... To this >>>



Top 6 State-of-the-Practice

#1 = Electronic Bidding & Contracts

#2 = Electronic & Digital Signatures

#3 = Document Management Systems (DMS)

#4 = Construction Management Systems (CMS)

#5 = Mobile Devices

#6 = MSAR

Top 3 State-of-the-Art

#1 = e-Ticketing

#2 = 3D Model as a Contract Document (MALD)

#3 = Data Sharing Between Steps & Silos

#4 = SmartPile
Inspector

Our **Newest** e-C Technology: SmartPile Inspector

SmartPile® Inspector: Solution



SmartPile Inspector v4.5

Project Name: SR 44 Bridge Replacement Structure: 110103 Bent/Pier: 4 Pile: 6

Project Hammer Activity Pile Elevation Driving Criteria Acquisition Acceptance

Hammer Info

Hammer: APE-D50-42-1310698

Manufacturer: APE

Model: D50-42

Type: ECH - External Combustion Hammer

Input Value: Stroke

Serial Number: 1310698

Rated Energy(kip-ft): 124.03

Max BPM: 60

Cushion Thickness & Material: 3-1/2 Aluminum 2 1-inch micarta

--Select--
 CED - Closed Ended Diesel
 ECH - External Combustion Hammer
 OED - Open Ended Diesel

Depth	Blows	BPM	Equivalent Stroke
46.00 - 47.00	22	58	1
47.00 - 48.00	21	59	1
48.00 - 49.00	25	58	1
49.00 - 50.00	16	58	1
50.00 - 51.00	21	57	1

Report

SmartPile Inspector v4.5

Project Name: SR 44 Bridge Replacement Structure: 110103 Bent/Pier: 4 Pile: 6

Project Hammer Activity Pile Elevation Driving Criteria Acquisition Acceptance

START ACQUISITION Audio Sensor

Drive Log

Start Depth	End Depth	Blows	Stroke	Ref Elev
102.5	103	36	5.56	1
103	104	79	5.8	1
104	105	87	6.72	1
105	106	72	7.12	1
106	107	63	7.41	1
107	108	61	7.58	1
108	108.5	31	7.49	1
108.5	109	18	7.92	1
109	110	52	7.8	1
110	111	54	7.75	1
111	112	56	7.75	1
112	113	52	7.76	1
112	113	0	0	0

Tip Elevation (feet) vs Number of Blows

Tip Elevation (feet) vs Stroke (feet)

Ref Elev (ft): Ref 1: 5.22

Depth Below Ref (ft): Current 112 Next 113

Blow: 2261

Stroke (ft): 7.67

Blows/Minute (BPM): 43

Potential Energy (kip-ft): 68.22

Max BPM: 60

Drive Log

Ref Elev (ft): Ref 1: 5.22

Depth Below Ref (ft): Current 112 Next 113

Blow: 2261

Stroke (ft): 7.67

Blows/Minute (BPM): 43

Potential Energy (kip-ft): 68.22

Max BPM: 60

Drive Log

Ref Elev (ft): Ref 1: 5.22

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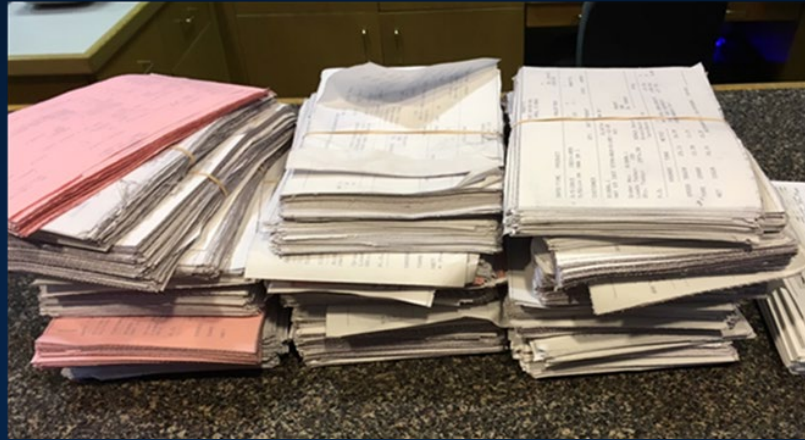
Max BPM: 60



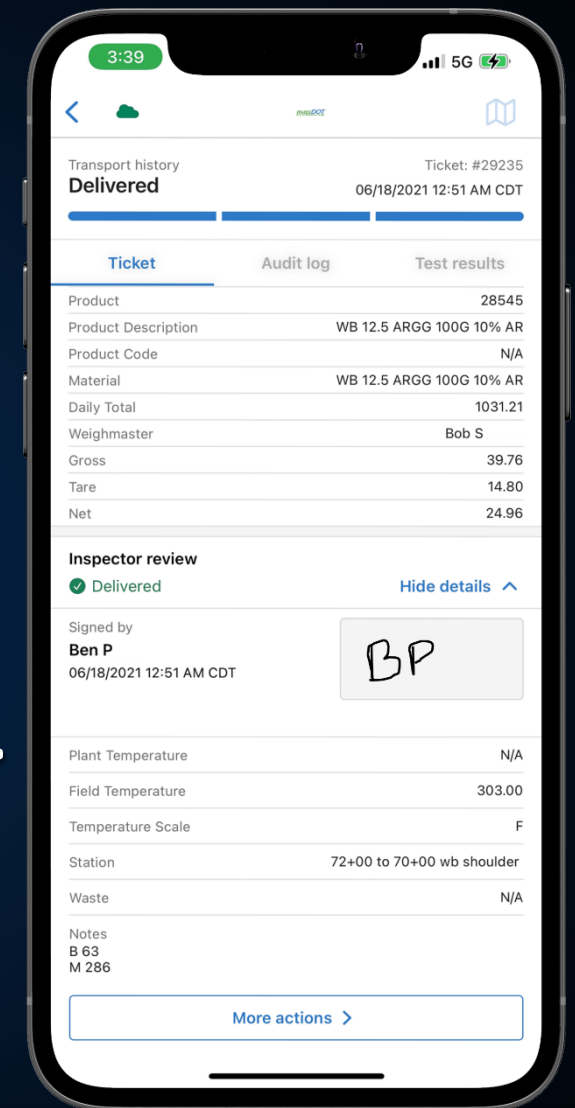
Source: SmartPile Inspector

What is e-Ticketing?

From this ...



... To this >>>



Source: Iowa DOT & Iowa Ready Mix Concrete Association, HaulHub Inc. – DOT Slip



U.S. Department of Transportation
Federal Highway Administration



What is the typical material ticketing practice?

A “Day in the Life” of a Ticket -Paper Ticket Handlers -



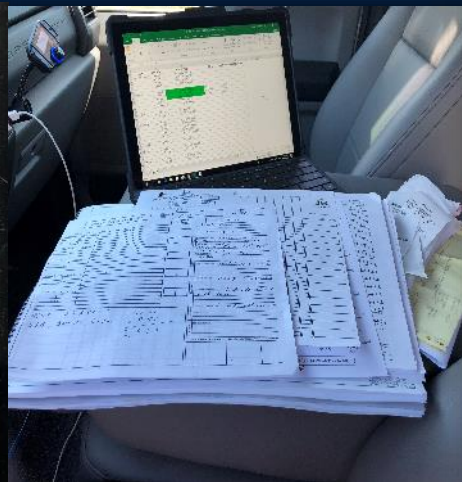
What is the typical material ticketing practice?

A “Day in the Life” of a Ticket - Paper Ticket Processing -

MAHNS READY MIX CO.
CENTRAL DIVISION - 280 WEST RIVER ST. - SPRINGFIELD, ILLINOIS - PHONE 217-244-1100
VALUITY INSTRUCTIONS

DATE	QUANTITY	CLASS	PRODUCT	UNIT	REMARKS
8/11/12	9	Flowfill		CY	

Handwritten entries on a paper ticket form, including a grid with numerical data and various notes.

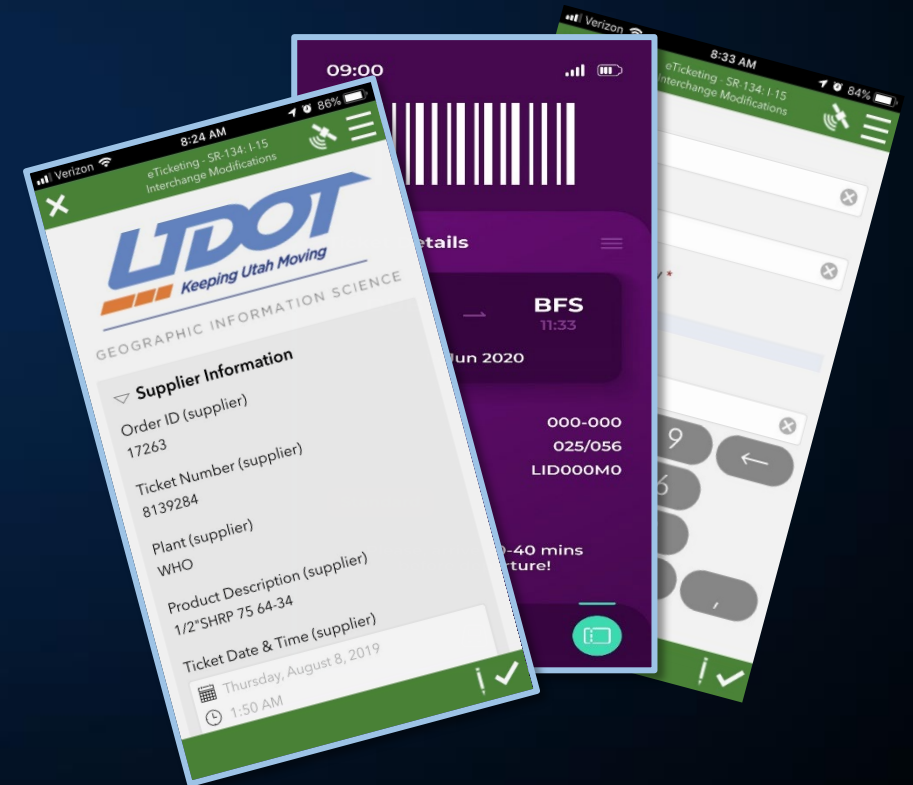


	A	B	D	E	F	K	L	M
	Date Created	Ticket	Product	Qty	UoM	WBS Element	Accepted	Product In
1	8/11/12	1078515	Flowfill	9	CY	4501.94	YES	458795
2	8/11/12	1078513	Flowfill	9	CY	4501.94	YES	458795
3	8/11/12	1078508	Flowfill	9	CY		YES	458795
4	8/11/12	1078503	Flowfill	9	CY		YES	458795
5	8/11/12	1078499	Flowfill	9	CY	4501.94	YES	458795
6	8/10/12	1078352	Class F - 4000 PSI	2	CY	4503.82	YES	458795
7	8/10/12	1078111	Class SS - 3600 PS	5	CY		NO	
8	8/10/12	1078100	Class SS - 3600 PS	7.5	CY	5005.81	YES	458245
9	8/10/12	1078039	Class C - 3600 PS	10	CY	5005.81	YES	458245
10	8/10/12	1077767	Class F - 4000 PSI	7.5	CY	5005.81	YES	458245
11	8/10/12	1077758	Class F - 4000 PSI	5.5	CY	5006.81	YES	458245
12	8/10/12	1077748	Class F - 4000 PSI	5.5	CY	5006.81	YES	458245
13	8/10/12	1077743	Class F - 4000 PSI	10	CY	5006.81	YES	
14	8/10/12	1077648	Class F - 4000 PSI	2	CY	4503.82	YES	
15	8/9/12	1077418	Class F - 4000 PSI	2	CY		NO	

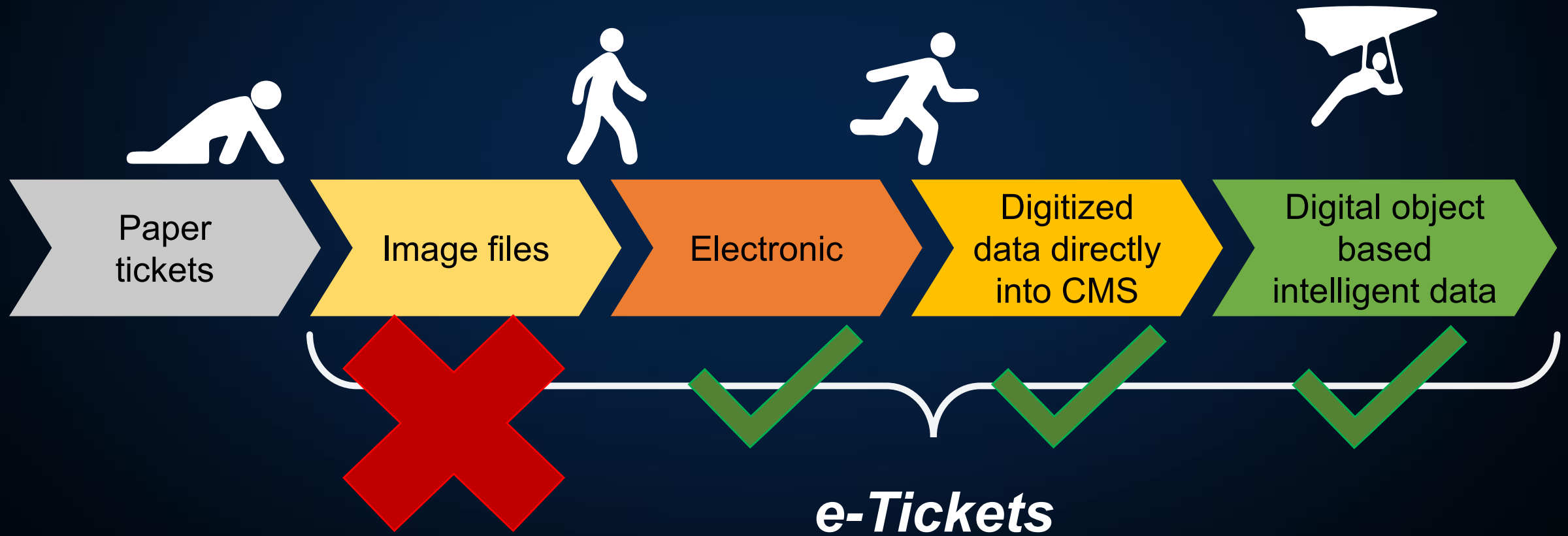


What is e-Ticketing?

➤ A **paperless process** for **producing, distributing, sorting, recording, and archiving** materials tickets, accessible in **real-time** via mobile devices.

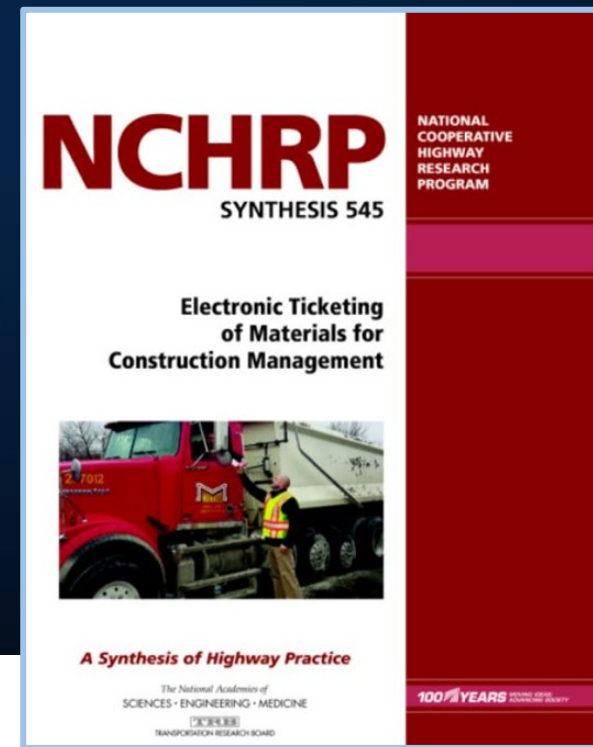


Evolution of e-Tickets



Laws, Policies, & Resources

- 2 CFR 200.335 Methods for Collection, Transmission and Storage of Information
- 23 CFR 635.123 Determination and Documentation of Pay Quantities
- 23 CFR 637 Construction Inspection and Approval
- 2 FHWA Memos
 - Computerization of Construction Records, 09/21/1989
 - Electronic Security, 07/07/1993
- e-Transaction Laws
 - Government Paperwork Elimination Act (GPEA) 1998
 - Electronic Signatures in Global and National Commerce Act (E-SIGN) 2000
 - Uniform Electronic Transactions Act (UETA) 1999



Source: FHWA

Q: e-Ticketing - - >> WHY?

#1: Improve worker **Safety**

#2: Simplify ticket **handling** using electronic and digital exchanges

#3: Facilitate **integration** of data into AASHTOWare (or other Construction Management System, CMS)

#4: Manage test results with **mobile devices**

#5: **Access** data before [and after] trucks arrive at jobsite

#6: **Environmentally** friendly!

SAVES
LIVES

SAVES
MONEY

SAVES
TIME



Q: e-Ticketing...WHY? Safety!

- Removes the need to take the ticket from the driver



View from the driver's seat

View from the ground



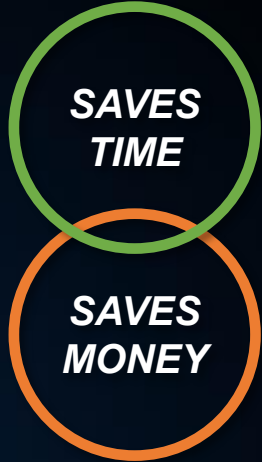
Safety

- Not a good place for inspector to be
- Picture this at night
- One wrong backward step
- Less visibility
- One slight weave by a driver...



Source: ALDOT

e-Ticketing – Real-time Information via web or app



Load-Out Time Tonnage Total Cycle Time

Load Cycle Analysis [Export to PDF](#)

Grand Totals This report expects the column LoadTime in the data, but it was not present

41539

Cycle Start Time	Load Time	Tons	Source Geo-zone	Dest Geo-zone	Time in Source	Time to Dest	Time in Dest	Time to Next Source	Total Time
2015-11-20 06:01:06	2015-11-20 06:48:17	23.61	Bourbonnais Plant	BASF Kankakee	52	25	40	29	146
2015-11-20 08:28:05	2015-11-20 08:31:41	23.62	Bourbonnais Plant	BASF Kankakee	15	23	44	-	82
-	-	-	-	BASF Kankakee	-	-	51	25	76
2015-11-20 11:09:07	2015-11-20 11:11:15	23.74	Bourbonnais Plant	BASF Kankakee	6	23	52	25	106
2015-11-20 12:55:07	2015-11-20 12:58:08	23.56	Bourbonnais Plant	BASF Kankakee	10	28	52	31	121
2015-11-20 14:56:07	2015-11-20 14:59:18	23.87	Bourbonnais Plant	BASF Kankakee	9	22	20	32	83
2015-11-20 16:19:07	2015-11-20 16:22:01	23.8	Bourbonnais Plant	BASF Kankakee	8	23	4	-	35
-	-	-	-	BASF Kankakee	-	-	17	37	54
2015-11-20 17:50:07	-	-	Bourbonnais Plant	-	8	-	-	-	8
Totals	-	142.2	-	-	108	144	280	179	711
Averages	-	23.7	-	-	15	24	35	29	79

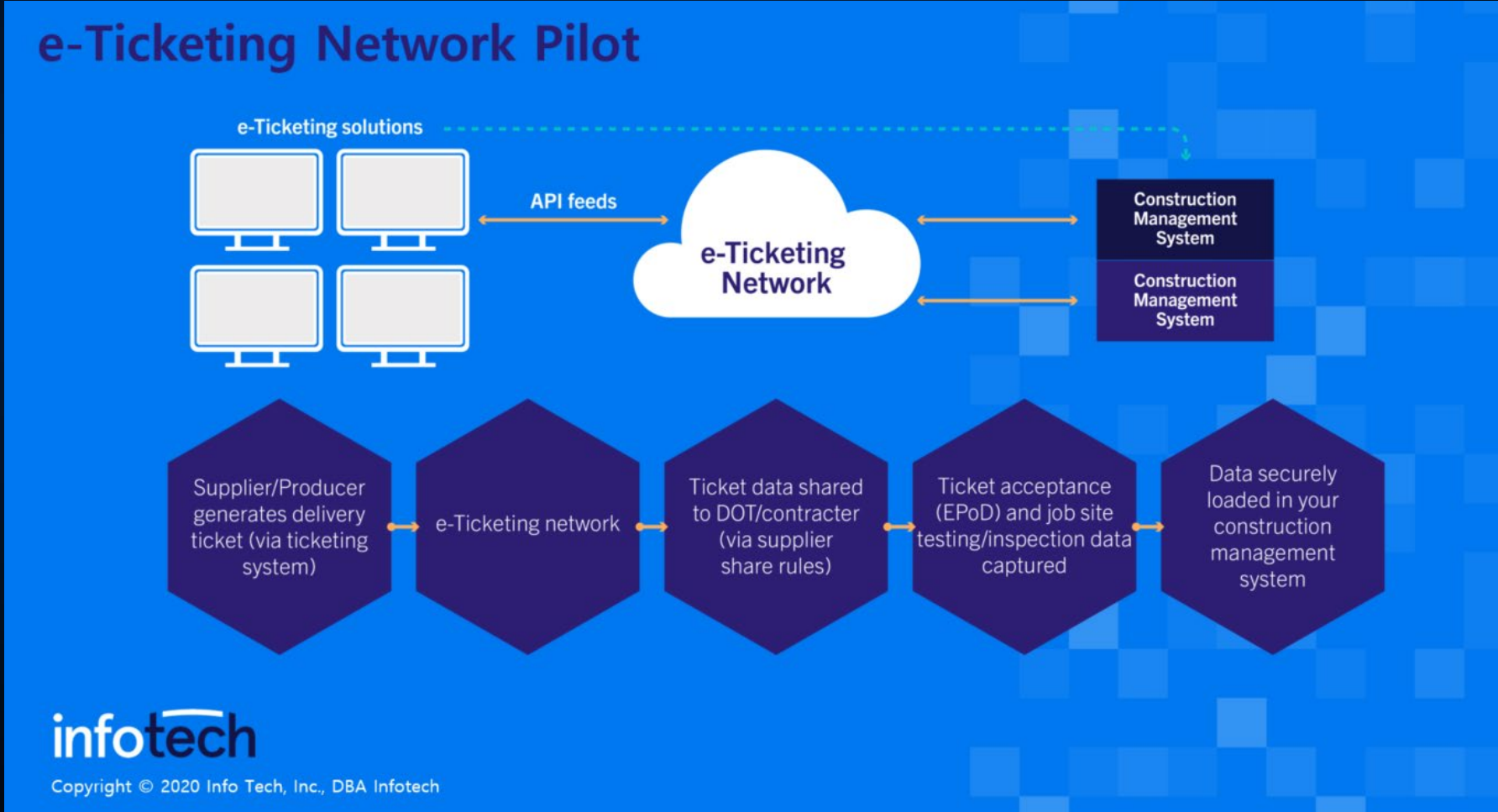
41533

Cycle Start Time	Load Time	Tons	Source Geo-zone	Dest Geo-zone	Time in Source	Time to Dest	Time in Dest	Time to Next Source	Total Time
2015-11-20 06:06:02	2015-11-20 06:52:02	23.67	Bourbonnais Plant	BASF Kankakee	49	25	73	22	169
2015-11-20 08:55:02	2015-11-20 08:58:30	23.61	Bourbonnais Plant	BASF Kankakee	7	20	28	-	55
-	-	-	-	BASF Kankakee	-	-	54	22	76
2015-11-20 11:10:02	2015-11-20 11:14:36	23.55	Bourbonnais Plant	BASF Kankakee	8	21	79	24	132
2015-11-20 13:22:02	2015-11-20 13:25:11	23.69	Bourbonnais Plant	BASF Kankakee	5	22	39	30	96
2015-11-20 14:58:02	2015-11-20 15:02:22	23.65	Bourbonnais Plant	BASF Kankakee	8	23	3	-	34
-	-	-	-	BASF Kankakee	-	-	15	31	46
2015-11-20 16:22:02	2015-11-20 16:26:25	23.88	Bourbonnais Plant	BASF Kankakee	7	23	2	-	32

e-Ticketing – Data Management, Transfer and Usage

SAVES TIME

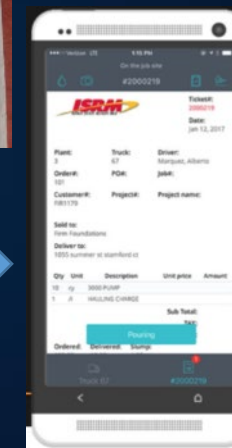
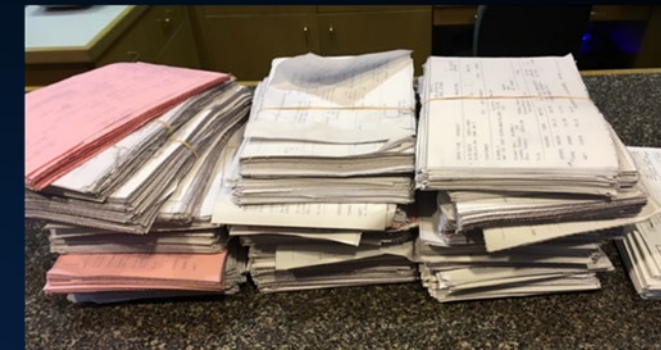
SAVES MONEY



What is e-Ticketing?

Types of e-Tickets

- State-of-the-Practice: The Big 3
 - HMA
 - PCC
 - Aggregate
- State-of-the-Art: the Others
 - Salt
 - Soil
 - Structural Steel
 - Rebar
 - Precast PCC: pipe, inlets, box culverts
 - Guardrail
 - Signs
 - Millings
 - Liquid asphalt/emulsions



PLANT		TRUCK	DRIVER	TICKET #	DATE
N		81	Terri Bratt	#327740	Sep 15, 2017
ORDER #		PO#	JOB#		
4		825			
CUSTOMER#		PROJECT#	PROJECT NAME		
ST1090		STELISS	Des Moines DO 103 Park Ave		
SOLD TO: Sternquist Construction					
DELIVER TO: 60 103 Park Ave Des Moines, IA					
PRODUCT NO.	QTY	UNIT	DESCRIPTION	UNIT PRICE	AMOUNT
DCLSDCA	10	cy	C-SUB 3 Agg SA Air, 5 oz #8 1 oz Ret		
200	10	cy	Hauling Charge		
				SUB TOTAL:	
				TAX:	
				TOTAL:	
ORDERED: 1200.00 DELIVERED: 20.00 SUM#P: 2.50					
LOAD TIME: 07:32:59 MAX WATER ALLOWED: 0.00 WATER ADDED BY PLANT: 0.00					
W/C RATIO @ PLANT: 0.57 W/C RATIO @ JOBSITE: 0.57					
	ACTUAL	MOISTURE	TARGET	UNIT	
LIMESTONE	14060	0.6% (1.21 g)	1.0%	LB	
SAND	13960	3.3% (101.81 g)	3.0%	LB	
LS 3" CHPS	3960	0.5% (2.42 g)	0.5%	LB	
CEMENT 1	3980		3970	LB	
FLYASH	1960		1960	LB	
RETARDER	120		119	OZ	
POLYHEM SA	90		90	OZ	
KB280	177		178	OZ	
WATER	201		203	GL	

Multiple Data Elements

Project & Contract Number

Plant Name & Location

Product Description

Truck ID, Load Times & Material Weights

Truck Transit Time & Routing

Temperature Measurements

Inspection Notes

Point of Delivery Location & Time Stamps at Paver

Wasted/Rejected Material Quantity

Daily Summary & Reports



TICKET #327740 DATE Sep 15, 2017

PLANT N TRUCK 81 DRIVER Leto, Brett
 ORDER# 4 PO# 835 JOB#
 CUSTOMER# STE1090 PROJECT# STE835 PROJECT NAME Des Moines- BO 103 Park Ave

TICKETED: 07:32:29
 TO JOB: 13:24:20

SOLD TO: Sternquist Construction
 DELIVER TO: BO 103 Park Ave Des Moines, IA

PRODUCT NO.	QTY	UNIT	DESCRIPTION	UNIT PRICE	AMOUNT
DCSUDSA	10	cy	C-SUD 3 Agg, SA Air, 5 oz WR 1 oz Ret		
200	10	cy	Hauling Charge		
SUB TOTAL:					
TAX:					
TOTAL:					

ORDERED: 1200.00 DELIVERED: 20.00 SLUMP: 2.50

LOAD TIME: 07:32:59 MAX WATER ALLOWED: 0.00 WATER ADDED @ PLANT: 0.00 WATER ADDED @ JOBSITE: 0.00
 W/C RATIO @ PLANT: 0.37 W/C RATIO @ JOBSITE: 0.37

	ACTUAL	MOISTURE	TARGET	UNIT
LIMESTONE	14260	0.6% (10.25 gl)	14266	LB
SAND	12600	3.3% (49.82 gl)	12596	LB
LS 3/8" CHIPS	3360	0.6% (2.42 gl)	3089	LB
CEMENT 1	3980		3970	LB
FLYASH	1950		1960	LB
RETARDER	120		119	OZ
POLYCHEM SA	90		90	OZ
KB1200	177		178	OZ
WATER	201		203	GL



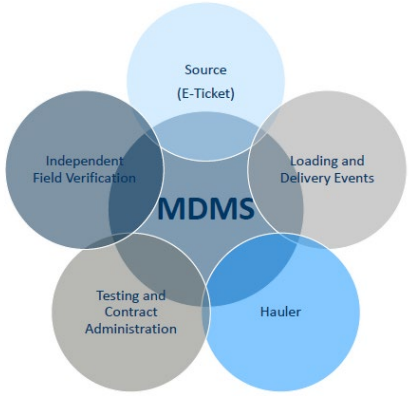
AASHTO Standard Specification

- AASHTO Provisional Practice for the Material Delivery Management System
- Publication in 2022 for Aggregate, Asphalt, and Concrete
- Pick and Choose which elements are most appropriate for your Agency
- Contact: Rebecca Embacher, MN DOT
 - rebecca.embacher@state.mn.us

Draft Last Updated 11/16/21 by Rebecca Embacher (Rebecca.Embacher@state.mn.us)

Standard Specification for
Material Delivery Management System

AASHTO Designation: M xxx-yy¹
Technical Subcommittee: No., Name
Release: Group n (Month yyyy)



AASHTO

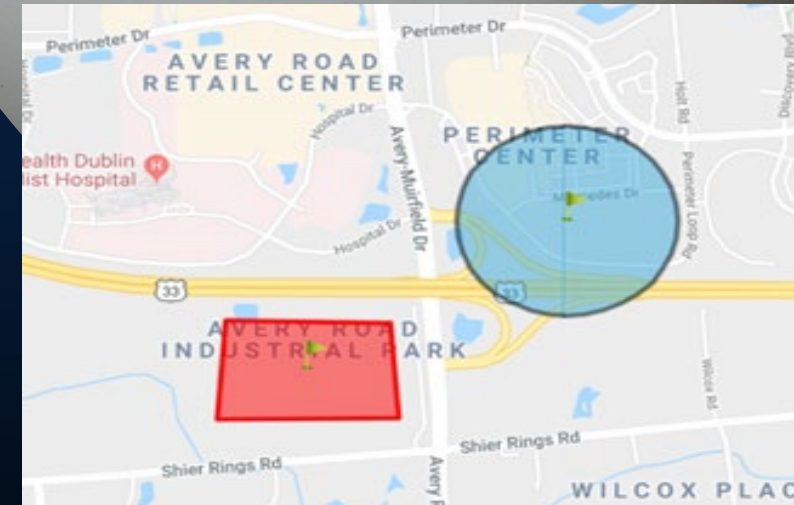
American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001

TS-no M xxx-1 AASHTO

e-Ticketing – GPS/GNSS ???

a.k.a. Bread-crumb Tracking

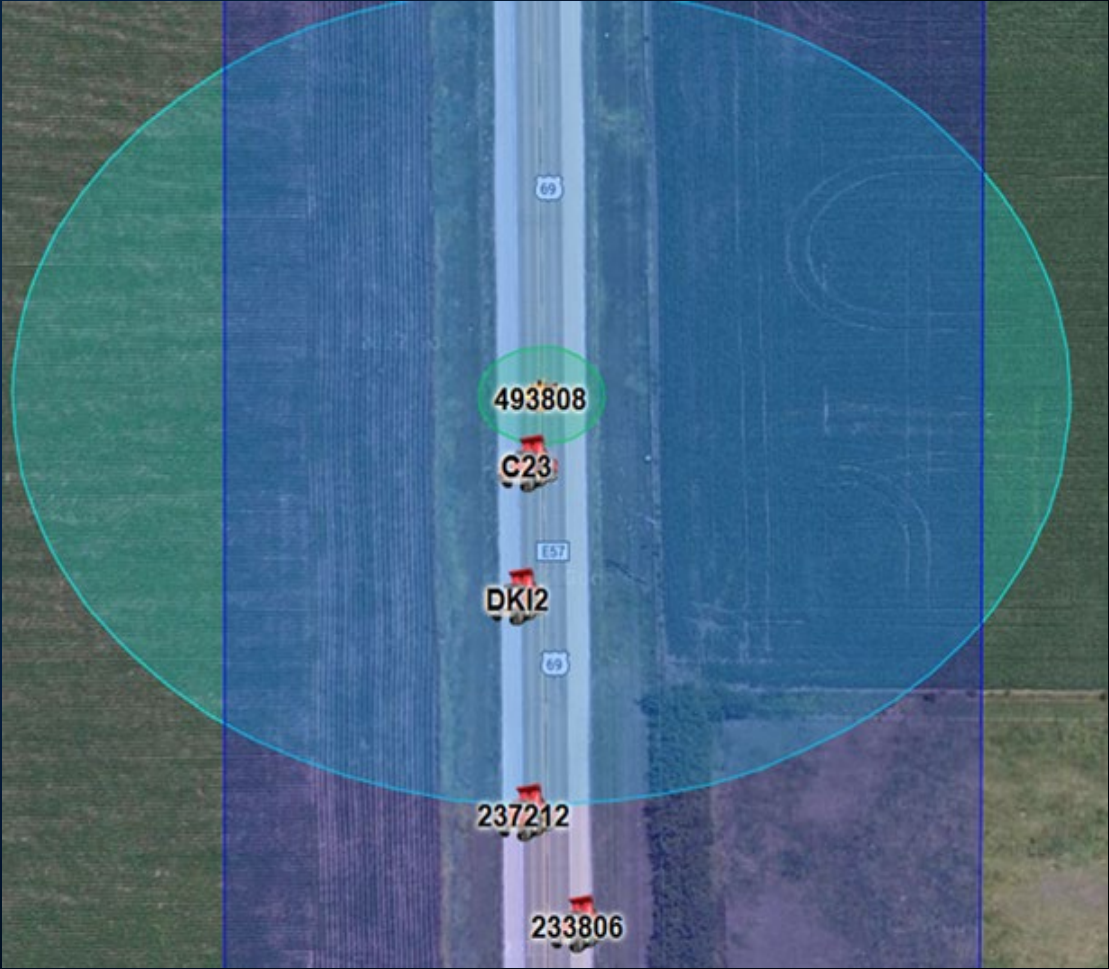
- **Optional, not required**
- Hard-wired, mobile app on smartphones, or cigarette lighter adapter
- Internal battery backup
- Ping every minute on haul vehicles
- Ping every 30 seconds on pavers/mills
- No user fees or special software required
- User based access to data based on privacy laws and contracts



Source: University of KY, KYTC

e-Ticketing – Geo Zones

plant – silos – paver – delivery vehicles



Delivery Log Image Module

What is e-Ticketing?

**

Other tracking methods

ATOLLOGY Nancy Test

Facility: Iowa DOT 2020-10-06 Delivery Log for October 6th, 2020
Truck Delivery Count: 60

Cycle List | Cycle Time Report | Analytics Dashboard | Delivery Log

Search... Filter by Tags

Truck: ER5553
Drop Off: 2020-10-06 14:43 CDT
Delivery Time: 19 minutes

Buggy Cam 2 Buggy Cam 1

14:43 14:44

Truck: ER5553
Drop Off: 2020-10-06 14:43 CDT
Delivery Time: 19 minutes

Truck: HB8528
Drop Off: 2020-10-06 14:29 CDT
Load & Delivery Time: 20 minutes

Truck: ER5555
Drop Off: 2020-10-06 14:07 CDT
Load & Delivery Time: 26 minutes

Truck: GG3002
Drop Off: 2020-10-06 14:32 CDT
Delivery Time: NA

Truck: HG2562
Drop Off: 2020-10-06 14:16 CDT
Delivery Time: 17 minutes

Truck: HB8528
Drop Off: 2020-10-06 13:44 CDT
Load & Delivery Time: 29 minutes

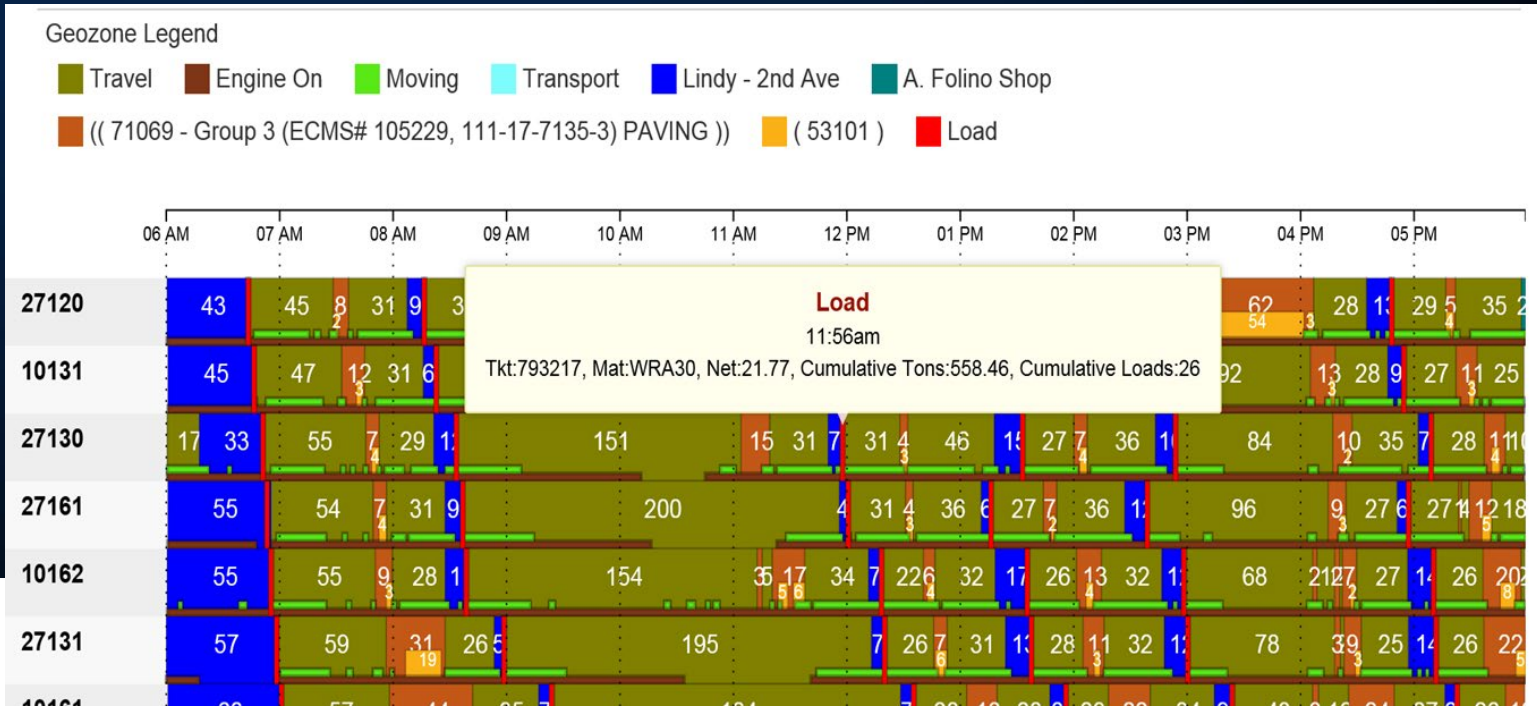
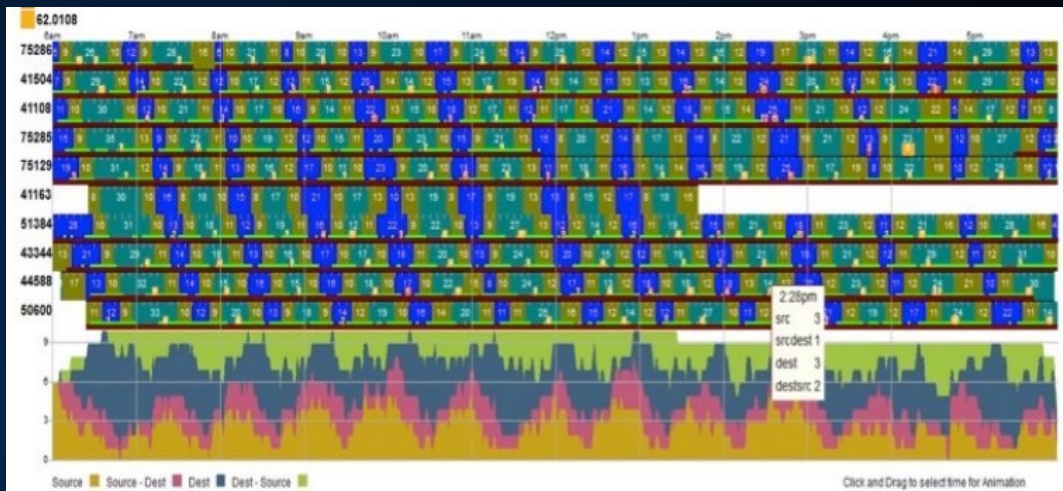
ATOLLOGY © 2020 Atology, Inc. v781ef8b9 Terms & Conditions

Any questions?

e-Ticketing - Contractor Benefits

FLEET SAFETY & FLEET DATA

- Real-time fleet management
- Eliminate bottlenecks at plant and/or paver
- Data for trucking payroll
- Fleet optimization



Source: KYTC, IOWA DOT

e-Ticketing – Inspection data

#70 Inspection at job site

AT JOB SITE

Air content
+ _____

Slump
+ _____

Concrete temperature
+ _____

Water added
+ _____

Revolutions

Unit weight

Discharged at: [click to select](#)

ACCEPTANCE

Concrete accepted

INSPECTOR SIGNATURE

eTicketing - SR-134-I-15
Interchange Modifications

LTDOT
Keeping Utah Moving

GEOGRAPHIC INFO

Supplier Info

Item Number: 27

Order ID (supplier): 17263

Ticket Number (supplier): 8139284

PIN: 15276

Plant (supplier): WHO

Product Description: 1/2"SHRP 75 64-34

Ticket Date & Time: Thursday, Aug 1:50 AM

Visually Verify Delivery *
 Yes
 No

Temperature (F): 270


Sample Taken
 Yes
 No

Reject
 Yes
 No

Partial Reject (Qty): _____

Notes

Point
 40°40'N 111°57'W ± 50 m



Sample Taken

Command Alkon

Water Added(Gal)	Qty on Truck	Time	Reason	+ Add
10.5	0	10:15 AM		<input type="checkbox"/> <input type="checkbox"/>
- 0 +	- 0 +	10:15 AM	Select	<input type="checkbox"/> <input checked="" type="checkbox"/>

Customer Signature

John

Clear Signature

Save

Driver Rating
★★★★★

Cancel Save

INSPECTION ON SITE

INSPECTOR: Ryan

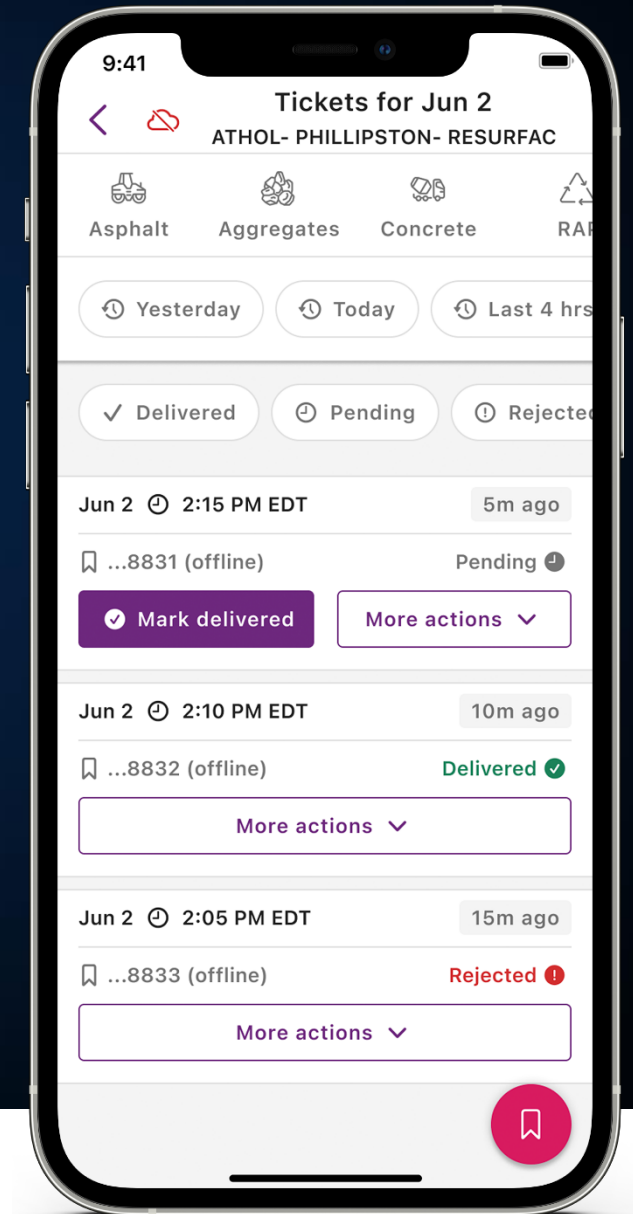
ACCEPTED

NOTES:
Sta 76+98 It

AIR CONTENT: 8.90 SLUMP: 0.00 TEMPERATURE: 83.0 F WATER ADDED: 0.00 DISCHARGE TIME: 09:53:49
 REVOLUTIONS: 30

EDC-6: e-Construction's e-Ticketing Deployment

- FHWA e-Ticketing Goals
 - Improve **safety** and efficiency through technology
 - Allow inspectors to **focus** on most demanding tasks
 - Improve **data** collection, sharing, and usage
- WIN-WIN
 - DOT: web-based exchange of material information
 - Contractor: fleet management, delivery tracking, faster payments, safety



Thank you for your attention!

Don't get buried in materials tickets.



Go digital.

 U.S. Department of Transportation
Federal Highway Administration

 EDC

www.fhwa.dot.gov/construction/econstruction

For FHWA support and opportunities for engagement involving e-T, please contact:

Kathryn Weisner
Matthew Corrigan

Resource Center, kathryn.weisner@dot.gov
Office of Infrastructure Research and Development,
matthew.corrigan@dot.gov



U.S. Department of Transportation
Federal Highway Administration

CENTER FOR ACCELERATING INNOVATION



Quiz the Fed... ... Q&A

Source: FHWA

