



## USING SMART TECH TO IMPROVE SAFETY OF WORKERS AND TRAVELING PUBLIC

MITCH WOOD  
DISTRICT 6 DMM  
IOWA DOT

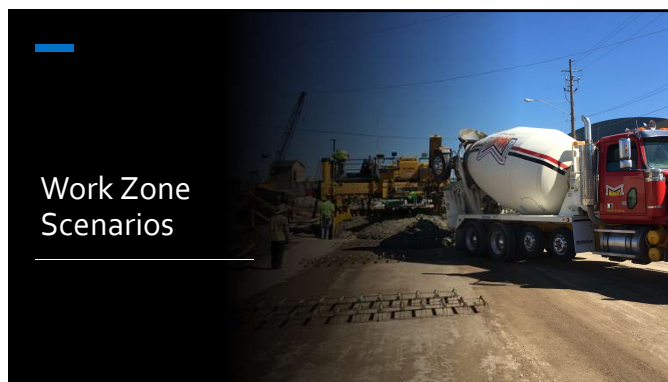
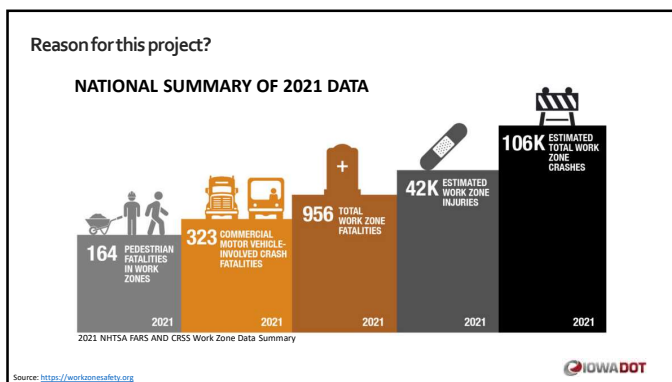
### Project Overview

Improve Transportation System Safety and Performance (Reduce Fatalities Below 300 Per Year)  
2. Improve Work Zone Safety

**2.a)** The Iowa DOT will identify and implement a statewide lane closure system (LCS) and implement policies that safely keep lanes open as much as possible. The concept of a LCS has been in development, and in 2022 we will implement the best system for our use case. We will also implement technologies targeted at improving worker safety. We will implement a pilot project that uses smart Internet of Things (IoT) technologies to help notify workers, supervisors, TMC personnel, and drivers when workers are too close to moving traffic, that provides real time work zone conditions and alerts to travelers/vehicles, and that outfits our equipment with advanced technologies for crash avoidance and mitigation.


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### Scenarios

Workers hit by construction equipment	<ul style="list-style-type: none"> <li>Trucks backing up</li> <li>Fast moving equipment on a closed roadway</li> <li>Material ticketing collection</li> </ul>
Traffic Control Setup	<ul style="list-style-type: none"> <li>Setting up and removing traffic control</li> <li>Flagger operations and complacency</li> </ul>
Moving Operations	<ul style="list-style-type: none"> <li>Paint and other moving maintenance operations</li> <li>Snow removal operations</li> </ul>
Nighttime Operations	<ul style="list-style-type: none"> <li>Low light visibility including sunrise/sunset timeframes</li> <li>Impaired drivers</li> </ul>
Work Zone Intrusion	<ul style="list-style-type: none"> <li>Errant vehicles enter active work zone</li> <li>Vehicles follow construction equipment into active work zone</li> </ul>






2022 Agency Objective: Improve Worker Safety

**Pi-Lit: Sequential Lamps**

- Category:** Worker presence, Visibility enhancement
- GOAL:** Provide an automated, more accurate, location & status (planned vs active) of the work zone. Also enhances visibility for worker safety.
- Targeted Use Cases:** Placed on top of barrels/drums in tapers to help guide motorists to move over.
- Output:** Data feed and impact notifications.
- Status:** Deployed 15 lamps on the nighttime I-74 overlay project in Davenport on August 11, 2022. The taper was moving locations each day. In October 2022, moved to I-80 nighttime project near Walcott. Through contract mods, Pi-Lit is working with TC contractors to deploy on more projects across the state during the 2023 construction season for testing and feedback from DOT/contractor staff.

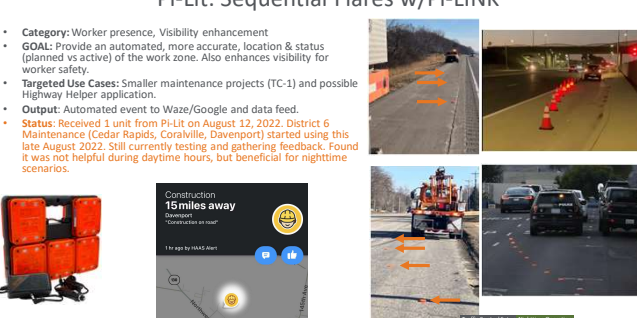


Three photographs showing the Pi-Lit Sequential Lamps in use: one on a barrel, one at night illuminating a road, and one on a construction site.

2022 Agency Objective: Improve Worker Safety

**Pi-Lit: Sequential Flares w/Pi-LINK**

- Category:** Worker presence, Visibility enhancement
- GOAL:** Provide an automated, more accurate, location & status (planned vs active) of the work zone. Also enhances visibility for worker safety.
- Targeted Use Cases:** Smaller maintenance projects (TC-1) and possible Highway Helper application.
- Output:** Automated event to Waze/Google and data feed.
- Status:** Received 1 unit from Pi-Lit on August 12, 2022. District 6 Maintenance (Cedar Rapids, Coralville, Davenport) started using this late August 2022. Still currently testing and gathering feedback. Found it was not helpful during daytime hours, but beneficial for nighttime scenarios.




Four photographs showing the Pi-Lit Sequential Flares: a close-up of the device, a night view of a road with flares, a mobile app interface showing a construction alert, and a road view with flares during the day.

2022 Agency Objective: Improve Worker Safety

**Pi-Lit: Smart Work Zone Box**

- Category:** Driver Safety, Work zone location accuracy
- GOAL:** Provide an automated accurate location. Get text/email notifications when there is an impact/hit to the device the box is attached.
- GPS location to mark begin/end of work zone.**
- Targeted Use Cases:** Placed on Road Work Ahead sign for project that moves every day. Placed another one on an attenuator in a work zone that is hit frequently.
- Output:** Data feed and impact notifications.
- Status:** Deployed 2 boxes on 8/15/22. One on frequently hit attenuator at I-80 EB MM 247.7 (near Iowa City). Second one on a frequently moving work zone, Road Work Ahead sign on I-80 in Scott County with Advanced Traffic Control.
  - Need to work with Methods prior to deploying more in District 1 for testing on attenuators.



Three photographs: a close-up of the Smart Work Zone Box attached to a sign, a close-up of the box on an attenuator, and a standard Road Work Ahead sign.

2022 Agency Objective: Improve Worker Safety

**iCone: Smart Rumble Strips/retrofit box**

- Category:** Work zone location accuracy
- GOAL:** Provide an automated, more accurate, location & status (planned vs active) of the work zone.
- DOT District Maint.** purchased 17 sets of portable rumble strips
- Retrofitting "non-intelligent" rumble strips with a device from iCone, to make them "intelligent".
- Can use device independent of rumble strips which is how these were tested the most.
- Output:** Automated event to Waze/Google and data feed
- Status:** Purchased 5 units from iCone. On 10/10/22 distributed to Maintenance in districts 1,3,& 4 for testing as well as 2 to Iowa Plains (contractor). Mainly tested the boxes in sign trucks, not rumble strips.



Two photographs: one showing the iCone device being retrofitted onto a truck's rumble strips, and another showing the iCone product boxes.

2022 Agency Objective: Improve Worker Safety

**iCone: iPins**

- Category:** Work zone location accuracy
- GOAL:** Provide an automated, more accurate, location & status (planned vs active) of the work zone.
- Output:** Automated event to Waze and data feed
- Status:** Received 2 units from iCone. On 10/10/22 distributed to Maintenance in districts 1 & 3 for testing.




Two photographs of the iPins: a yellow pin and a red and white traffic cone with a pin attached.


2022 Agency Objective: Improve Worker Safety

**SafeAll: Traffic Commander DMS**

- Category:** Moving Operations
- GOAL:** Provide a clear message to traffic about a mobile work zone ahead.
- Output:** Not a connected device. Doesn't connect to the Traffic Management Center.
- Status:** Installed one test sign from Zip's on one of our paint crew pickup trucks in D6 on 5/9/23. Very positive feedback from the paint crew. Evaluating purchasing options.



Three photographs: a close-up of the Traffic Commander DMS screen, a pickup truck with the device installed, and a truck at night with the DMS sign illuminated.

2022 Agency Objective: Improve Worker Safety 

### What did we learn?

- **New technology** – not fully developed
  - We gave feedback to some vendors and they made changes right away
- **Work zone intrusion & worker/machine encroachment** scenarios were our high priority scenarios, but most **underdeveloped technologies**.
- Not all **pilots** are free
- **Supply chain issues** delayed receiving some devices
- Need more **organized format for feedback** from users on different technologies.
- The smaller the **evaluation team**, the better (for our objective).
- **Training** on the new devices is crucial. Initially and then reminders.
- It's important to show our staff what the **traveling public sees** as a result of them using this technology (e.g. Waze events). What's the payoff for them to do this extra work?



## Technologies in Progress

2022 Agency Objective: Improve Worker Safety 


### VTTI: Smart Work Zone System

- **Category:** Worker wearable, proximity sensor
- **GOAL:** Provide an automated worker notification when vehicles are nearby or intrude into the work zone. Alerts workers if they get too close to defined work zone boundary or equipment w/proximity sensor.
- **STATUS:** Working with VTTI on an MOU to be a test location for some of their system.

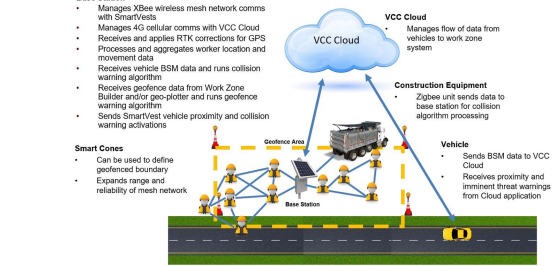


Smart Vest, Cone, Base Station, Work Zone builder app




2022 Agency Objective: Improve Worker Safety 

### VTTI: Smart Work Zone System Smart Work Zone Configuration






- Base Station**
  - Manages XBee wireless mesh network comms with SmartVests
  - Manages 4G cellular comms with VCC Cloud
  - Receives and applies RTK corrections for GPS
  - Processes and aggregates worker location and movement data
  - Receives vehicle BSM data and runs collision warning algorithm
  - Receives geofence data from Work Zone Builder and/or geo-plotter and runs geofence warning algorithm
  - Sends SmartVest vehicle proximity and collision warning activations
- VCC Cloud**
  - Manages flow of data from vehicles to work zone system
- Smart Cones**
  - Can be used to define geofenced boundary
  - Expands range and reliability of mesh network
- Construction Equipment**
  - Zigbee unit sends data to base station for collision algorithm processing
- Vehicle**
  - Sends BSM data to VCC Cloud
  - Receives proximity and imminent threat warnings from Cloud application

2022 Agency Objective: Improve Worker Safety 

### DOT AVL Data

- **Category:** Work zone location accuracy
- **GOAL:** Provide an automated, more accurate, location & status (planned vs active) of moving and static maintenance operations.
- **Targeted Use Cases:** Maintenance Operations – moving and static
- **Output:** Waze and data feed into ATMS to notify the TMC when and where Maintenance Operations were occurring.
- **Status:** Working with InTrans to do this work. Coding is done and working on QA/QC testing.

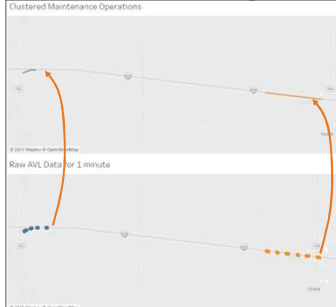



2022 Agency Objective: Improve Worker Safety 

### Example DOT AVL data clustering

Criteria:

- 1-minute clusters
- 0.4-mile grouping
- Speed < % of speed limit




2022 Agency Objective: Improve Worker Safety 

### Site 20/20: Guardian Cone


- **Category:** Worker Wearable, Proximity Sensor
- **GOAL:** Provide an automated worker notification when vehicles are nearby.
- **Targeted Use Cases:** Smaller maintenance and construction projects.
- **Output:** None
- **Status:** GPS/data feed version was not available summer 2022. Ordered the version that does not send a data feed w/GPS or Waze alerts. Product delivered earlier this year. Need to have tested in field.



2022 Agency Objective: Improve Worker Safety 


### Site 20/20: Guardian Cone



2022 Agency Objective: Improve Worker Safety 

### Objective Closeout and Continuing Efforts

- Will continue with the technologies we discussed for the 2023 construction season.
- Will evaluate and summarize our findings of all the technologies we tested.
- Will look for a more permanent location to continue evaluating and testing worker safety technologies (e.g. Work Zone Council).



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