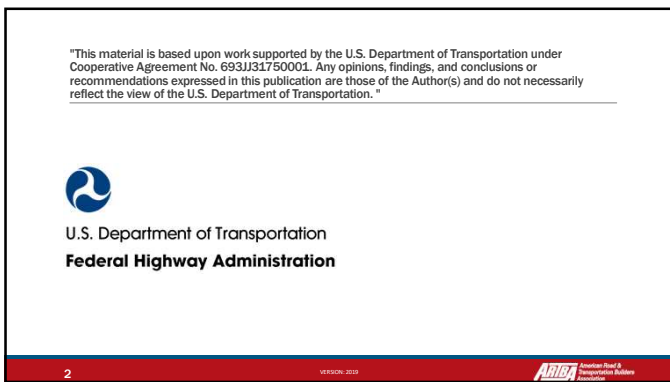
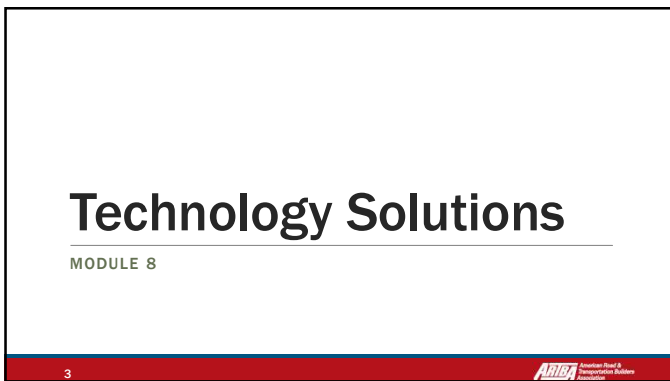




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Learning Objectives

- Explain how technology can help us to reduce runovers and backover incidents in the work zone
- Identify the available technologies and its terminology
- Understand how too much technology can be a problem too




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Are there technological solutions?


THERE ARE A VARIETY OF TECHNOLOGIES—OLD AND NEW—THAT HAVE BEEN DEVELOPED TO WARN DRIVERS AND OPERATORS WHEN WORKERS ON FOOT ARE NEAR, INCLUDING:

- Alarms
- Cameras
- Radar
- Sonar
- Tag Systems



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Technology
Uber case

6

VERSION: NOVEMBER 2017



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Terminology

Proximity Detection: Detection of personnel, vehicles and other objects near a machine using a sensor technology

Proximity Warning (Collision Warning): Detection of personnel, vehicles and other objects near a machine resulting in alarms

- Warn only operator
- Warn operator and nearby personnel (two-way)

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Terminology (continued . . .)

Collision Avoidance: The processing of sensor information resulting in control signals or actions that alter machine status/movement to avoid a collision

- Computer Control
- Human Control

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Proximity Detection

Independent or stand alone systems

Network-based systems requiring supporting infrastructure

Actions range from simple alarms to machine control (setting brakes, limiting movement, etc.)

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Proximity Detection Approaches

Independent systems:

- Passive sensing of obstacles and personnel
 - Reflected Signals
 - Non-discriminating
- Cooperative systems require communication between machine-mounted systems and systems on obstacles or personnel (which participate in detection)

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Proximity Detection Approaches

Network-Based Systems:

- Cooperative and require other infrastructure on the job-site (GPS or other communication system)

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Collision Avoidance Approaches

Increase situational awareness:

- Visual, audible, tactile alarms
- Two-way alarming
- Human in the loop

Machine Control

- Processing of sensor information
- Automatic control of machine functions

Combination of both

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Considerations

The approach to avoiding runovers, backovers, or pinning workers depends upon the type of equipment and its associated risks:

- Operator on board
- Operator adjacent to equipment
- Blind Areas
- Speed of machine
- Risk to near-by workers or vehicles

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Camera Systems

Use of cameras to see blind spots is a proven technology that is used in many industries. Special considerations for roadway construction applications include:

- Appropriate mounting locations (especially dump trucks)
- Keeping camera clear of dirt and grime
- Ensuring drivers/operators look at monitor

Challenges:

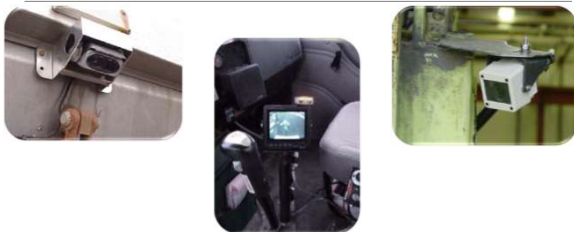
- Cameras get dirty
- Operator must look at monitor to be aware of workers

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Camera Systems



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Sonar

Sonar devices use sonic waves to detect a person or object that enters their field of perception. When something is detected in the field, it sounds an alarm.

Challenges with this technology:

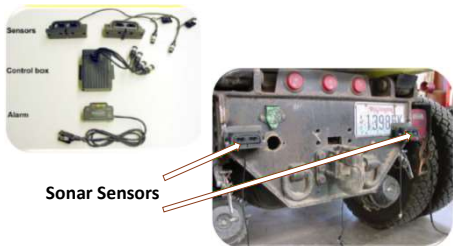
- Detection cannot discriminate as to what "objects" will trigger alarm
- Operator hears "false alarms" when object in field is not a hazard
- Has a relatively short detection distance
- Detector must be carefully mounted so as not to detect the ground or parts of the equipment.

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Sonar



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Radar

Radar-based proximity detection:

- Pulsed or continuous wave
- Multiple antennas positioned to monitor blind areas
- Display in cab provides audible and visual warnings, with graded alarms
- Typically short range for slow moving scenarios (25-75 feet)



Challenge

- Detector must be carefully mounted so as not to sense the ground or parts of the equipment.

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Radar

Best: Radar and Camera Used in Combination

Radar Antenna



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Available Technologies

An emerging technology with effective results in other industries involves two-way communication between a system mounted on equipment and detectors on workers (or other machines). This is known as a "Tag Based" system

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Available Technologies

Radio Frequency Transceivers and Tags

- Radio Frequency Identification
- Heavy equipment and light vehicles are fitted with transceivers
- UHF or VHF

Challenges with this technology:

- Every worker must be tagged and each piece of equipment must have a detection device

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RFID Technology

RF Tags mounted on equipment (multiple locations) and workers

Two-way alarms warn operator and others near-by

Location determined by the RF unit that detects the other tag (front, rear, left, right) and shown on display

Adjustable Range

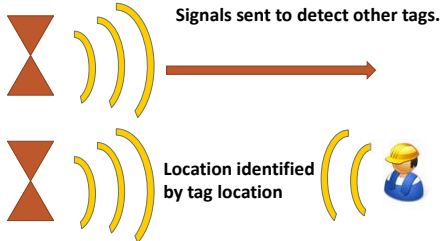
Used with Cameras

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How it Works



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Tag - Identifies Worker Near-by



Audible sounds or vibration warn worker and operator. Operator warned to look in monitor.

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Global Positioning System (GPS)

Equipment or vehicle location determined using GPS

Location broadcast to other nearby equipment

Proximity warning alarms and location displays



Challenges with this technology:

- Every worker must be tagged and each piece of equipment must have a detection device

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Global Positioning System (GPS)

GPS installed on equipment (dump trucks, pavers, rollers)

GPS receivers installed on Workers



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GPS Technology



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GPS Technology



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Emerging Technologies

Intelligent Video Systems

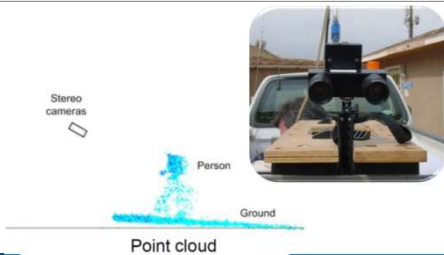
- Computer-assisted stereovision cameras
- Video signal processing allows for detection based on 3D position
- Provides view of blind area near equipment and proximity warning using only cameras
- HAZ CAM system trials on haul trucks

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Intelligent Video Systems




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Additional Work & Considerations

- Reduce nuisance alarms and false stops
- Effective alarm presentation and context considerations
- Operator interfaces and combined displays
- Are systems overloading operators? Are they distractions?
- Behavior changes in operators
- Wearable sensors appropriate for tasks and environment

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Technology
Blind Spots


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Resources

NIOSH Proximity Detection Web Page:

www.cdc.gov/niosh/topic/highwayworkzones/
www.cdc.gov/niosh/mining/topicspage58.htm

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Discussion and Questions

END MODULE EIGHT

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