

# 2017 GCAA Management Workshop

## Introduction to Proximity Warning Systems

# Credits:

- Presented by:
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- *Many of the resources used in this presentation were provided by NIOSH, CDC and MSHA.*
- *Some images and charts were provided by independent companies and are credited where appropriate.*

# Proximity Warning Systems

1. Research
2. Industry Issues and Statistics
3. PWS Technologies
4. How PWS can help
5. Event Reporting – the “near-missing” link
6. Videos

# Research

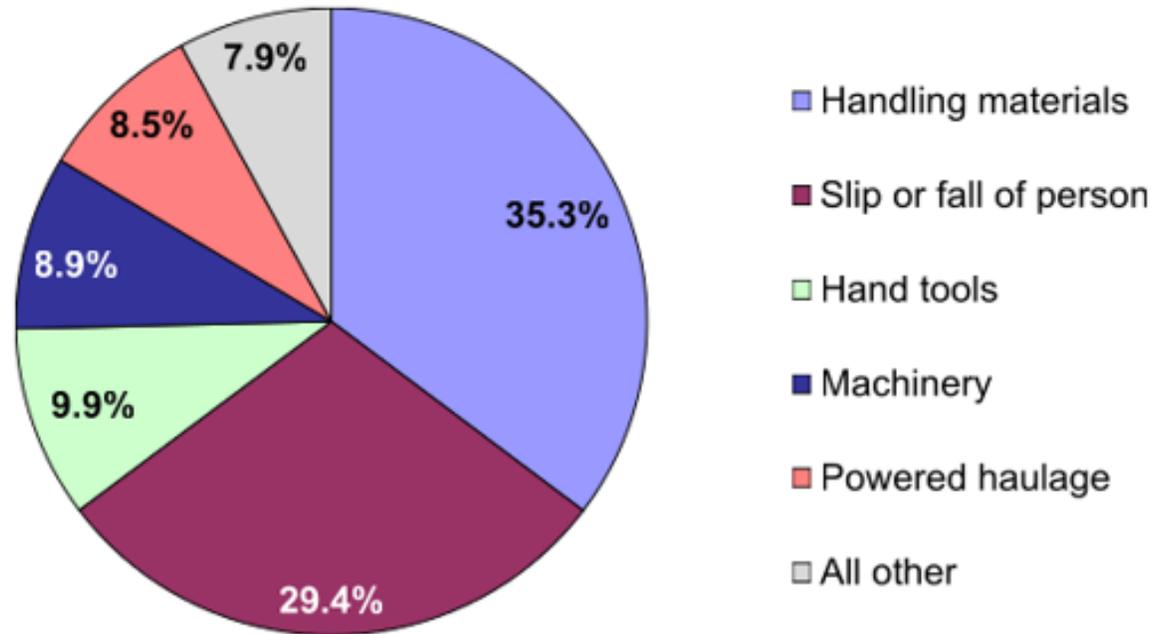
- Niosh
  - Many studies conducted of PWS systems up until 2007
- CDC
  - Statistics of workplace injuries
- MSHA
  - Best practices
  - Fatalgrams
- GA Tech
  - Proximity Warning System testing and development

# NIOSH – Analysis and Data

- As an independent third party NIOSH has conducted and funded many studies regarding haulage and other types mining accidents. The following information is a very condensed summary of years of data and test trials that have been conducted.
- Technology is continuously advancing. The information presented here should be taken in the context of a guide to start your own research into what Proximity Warning Systems are appropriate for your worksites.
- It is very important to note: In almost all PWS applications, the system is only an **OPERATORS AID**. The reaction to the warning given by the PWS is still ultimately the equipment operators responsibility.

# The Industry Issues – Surface Mining

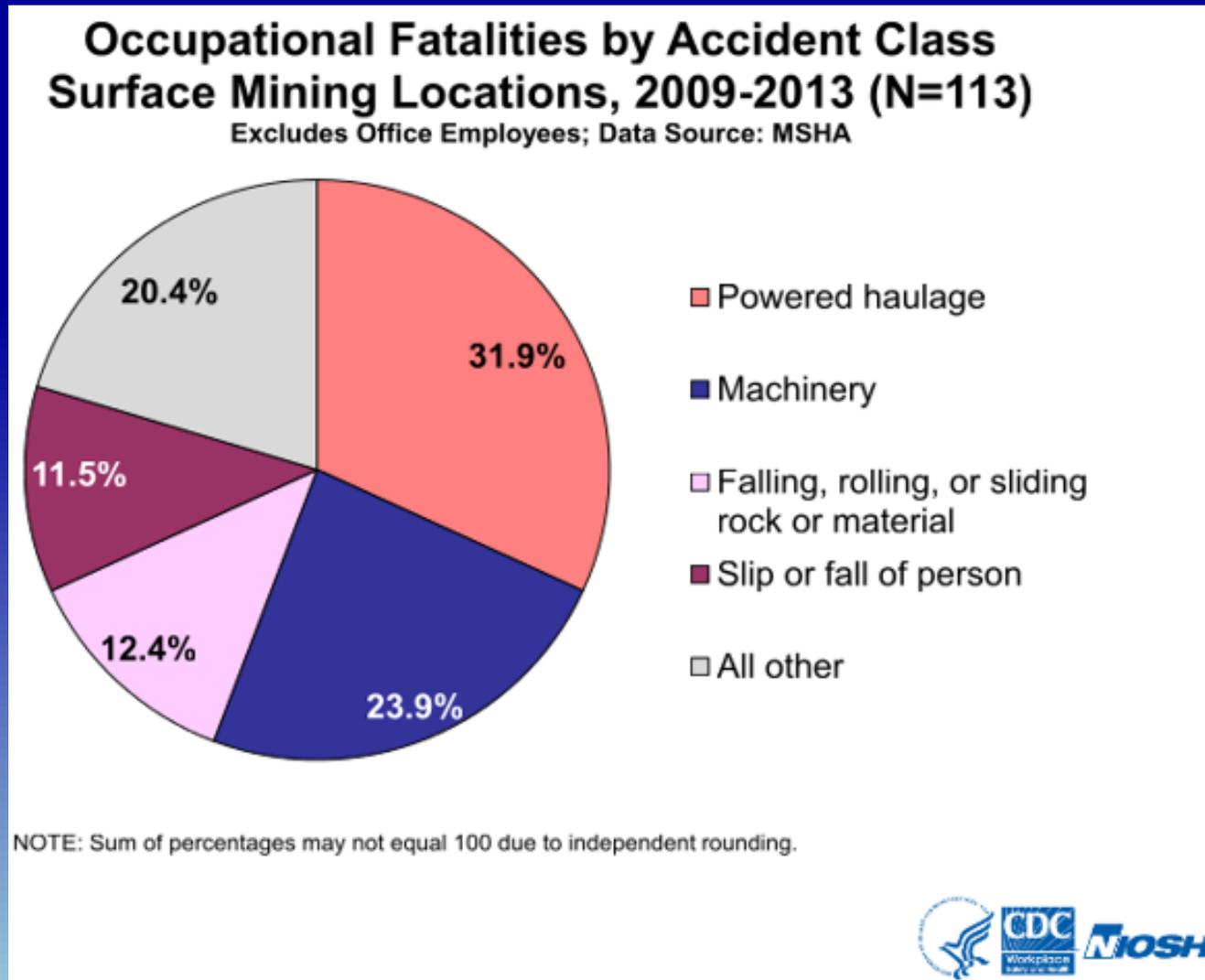
**Nonfatal Lost-time Injuries by Accident Class**  
**Surface Mining Locations, 2009-2013 (N=17,084)**  
Excludes Office Employees; Data Source: MSHA



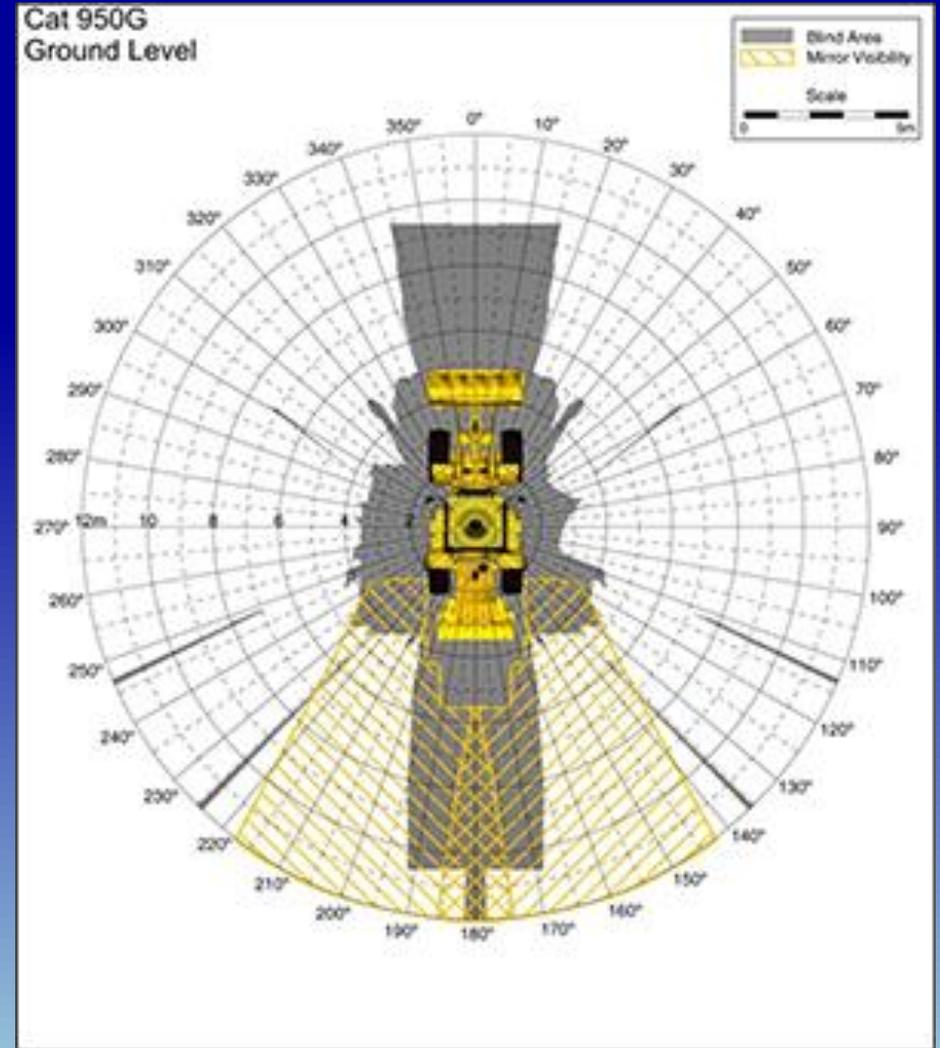
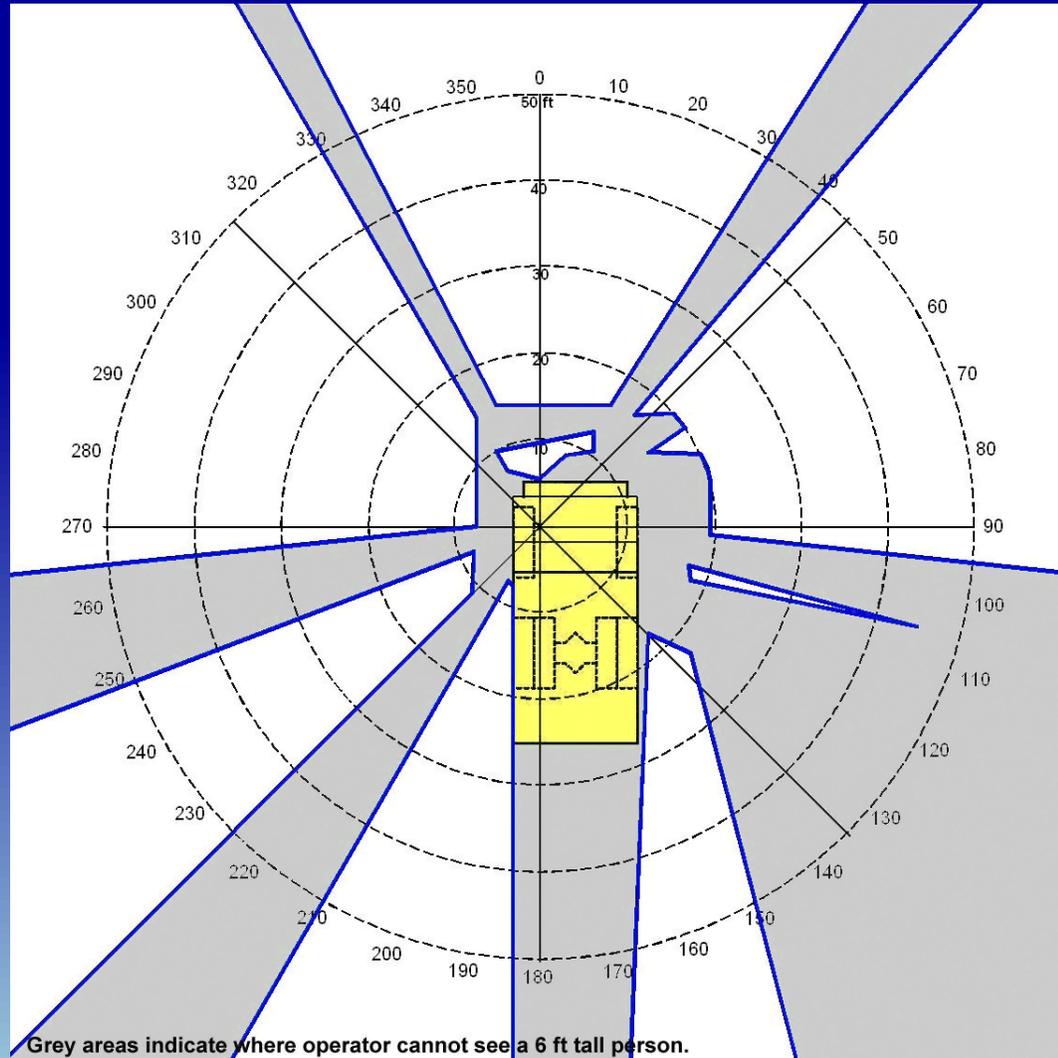
NOTES: (1) Nonfatal injury cases classified under "Machinery" were reclassified as a "Fall of ground (from in place)" if the source of the injury was "Caving rock, ore, etc." This reclassification is consistent with how MSHA classifies similar incidents which resulted in a fatal injury. (2) Sum of percentages may not equal 100 due to independent rounding.



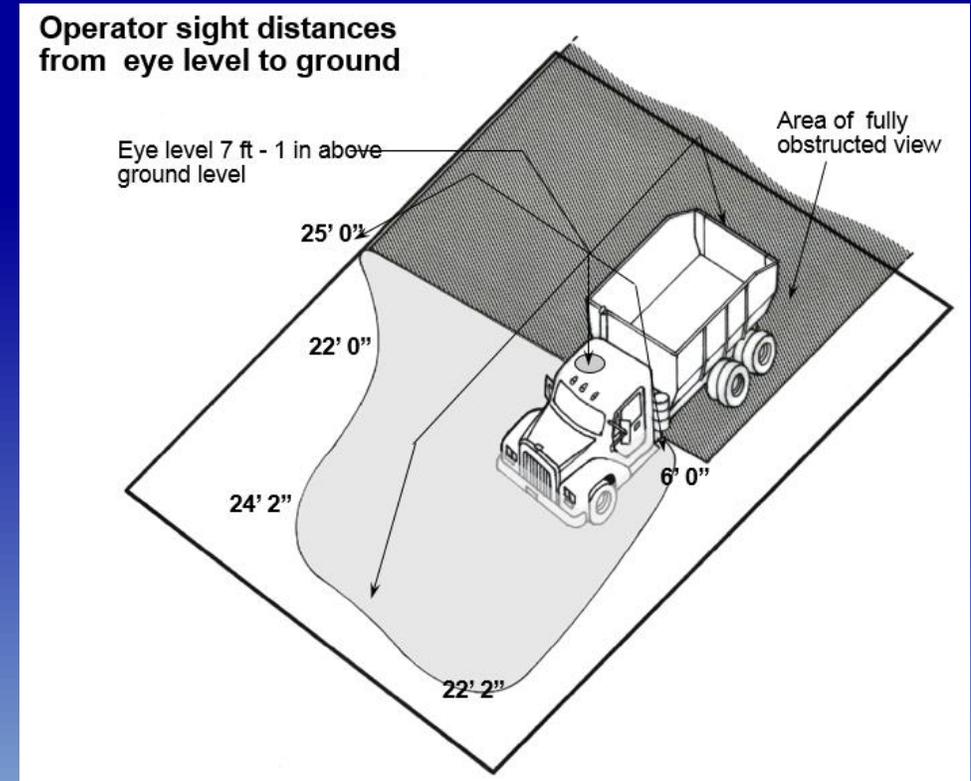
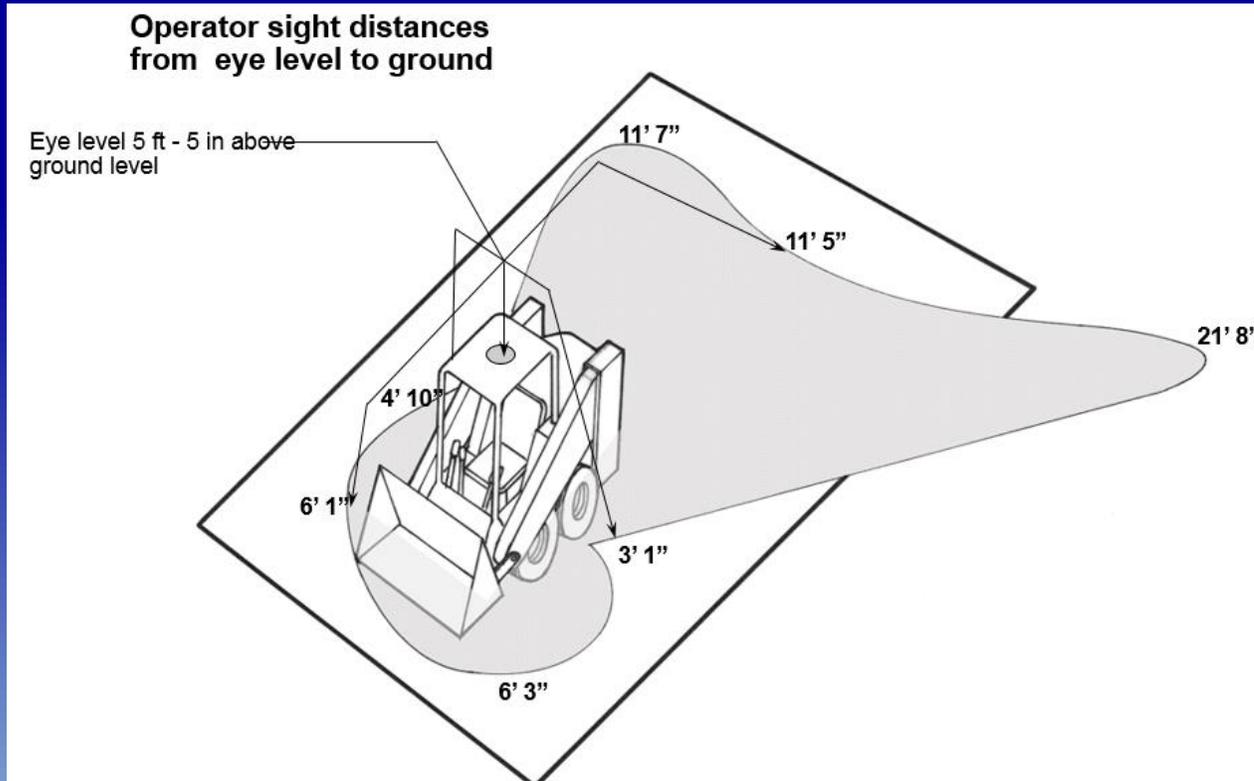
# The Industry issues – Surface Mining



# Visibility with Mobile Equipment



# Visibility with Mobile Equipment



# Types of PWS

Type	Advantages	Disadvantages	Sensing method
Ultrasonic - pulse	Compact and easy to install.	All objects trigger alarm. Temperature, humidity, air turbulence, and many other factors cause accuracy problems.	Detects change in time-of-flight reflection due to object in detection zone.
Radar: pulsed	Compact and easy to install.	All objects trigger the alarm. Snow and ice buildup and angle of incidence, accuracy issue.	Measures time-of-flight of a pulse that is transmitted and then reflected off of objects in detection zone.
Radar: Doppler	Compact and easy to install. Measures vehicle speed.	Cannot detect stopped objects. Snow and ice buildup issues.	Detects a frequency shift in generated signal due to object in detection zone.

# Types of PWS

Type	Advantages	Disadvantages	Sensing method
Video cameras	Simplicity. Video Recording	Operator must observe monitor. Limited field of view.	Vehicle operator monitors objects in blind spots on cab-mounted monitor.
Stereo Video system	Simplicity. Can discriminate between personnel and objects. Event logging and video recording	Limited field of view.	Vehicle operator monitors objects in blind spots on cab-mounted monitor. System has different audible and visual alarms for personnel or objects.
RFID: active	Longer range than passive RFID. Near Miss Tracking	Requires battery in tag. Orientation sensitivity.	A battery-powered tag detects generated radio signal.
GPS	Accurate; covers wide areas.	Only works on the surface.	A receiver detects satellite signals and triangulates position, transmits location to other vehicles/personnel via radio.

# Types of PWS

Type	Advantages	Disadvantages	Sensing method
Magnetic: passive	Compact and easy to install.	Accuracy issues when metallic objects in field.	Detects change in Earth's magnetic field when objects enter detection zone.
Magnetic: active	Great accuracy over short distances.	Only receiver in detection zone triggers alarms.	A transmitter provides a marker signal. A receiver measures signal strength and provides alarms.

# How Can a PWS Help?

There are three main types of incidents that mobile equipment are typically involved in:

- 1)V2V – Vehicle to Vehicle
- 2)V2P – Vehicle to Personnel
- 3)V2I – Vehicle to Infrastructure

The best solution may be a combination of Proximity Warning Systems

# Radar, GPS, Magnetic and RFID

November 7, 2013 Surface Gypsum - A front-end loader traveling with a full bucket in the elevated position collided with a water truck in front of the rusher feed ramp. The rising sun temporarily blinded the loader operator, who did not see the water truck in his path. There was extensive damage to the truck's cab but no injury occurred .



# Radar, GPS, Magnetic, Video and RFID



# Magnetic and RFID

October 22, 2014

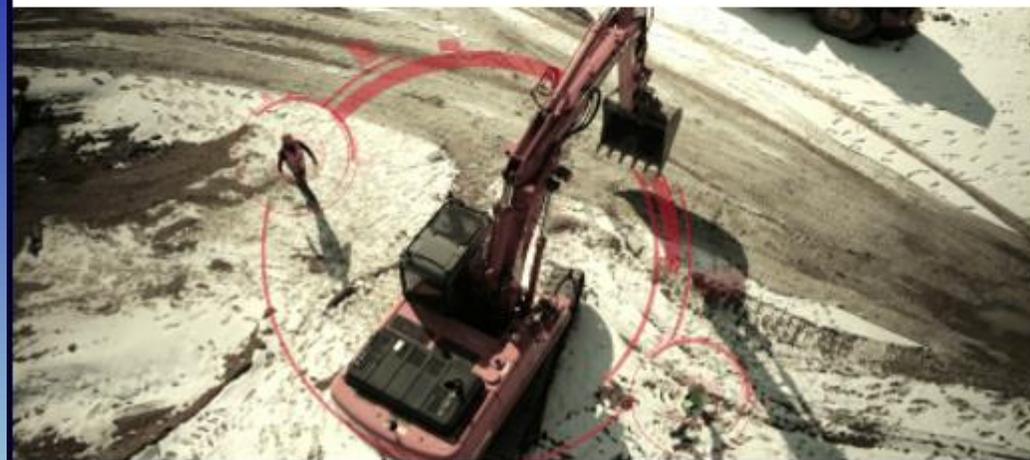
Surface Sand & Gravel mine - The crushing superintendent was leaning across a 42-inch belt conveyor while attempting to remove a portion of the rubber belt skirting. The belt conveyor was not locked out and was started remotely. The superintendent fell onto the belt and was pulled under the portable crusher 18 feet toward the discharge point. He managed to grab the cross belt magnet frame and hold on until the conveyor was stopped.



# Magnetic and RFID



SAFE OPERATING ZONE



DANGER ZONE

# The Near Missing Link

- The one thing that most Proximity systems are missing
- Black box technology
- Video
- GPS
- Machine ID
- Worker ID
- Position in relation to machine

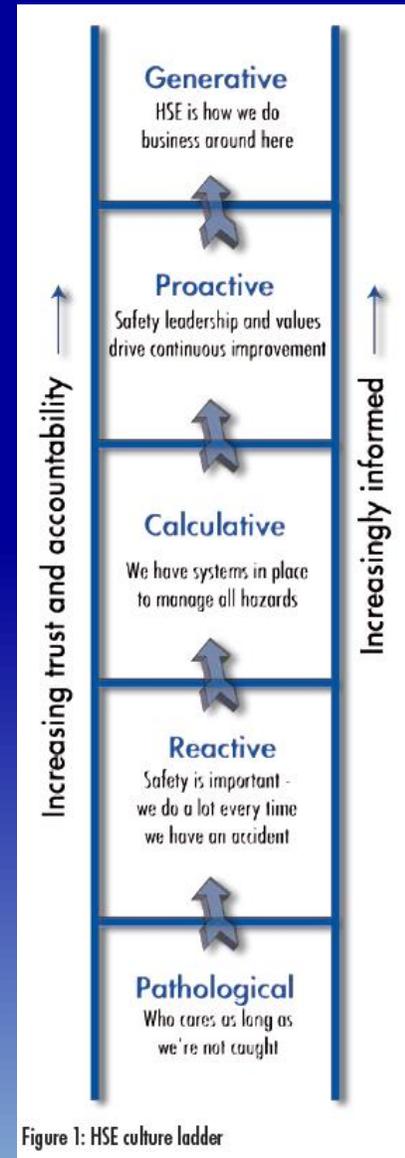
# What is a Near Miss?

A **Near Miss** is an unplanned event that did not result in injury, illness, or damage – but had the potential to do so. Only a fortunate break in the chain of events prevented an injury, fatality or damage; in other words, a miss that was nonetheless very near.

A faulty process or management system invariably is the root cause for the increased risk that leads to the near miss and should be the focus of improvement. Other familiar terms for these events are a “**close call**,” a “**narrow escape**,” or in the case of moving objects, “**near collision**” or a “**near hit**.”

# Why collect near miss evidence?

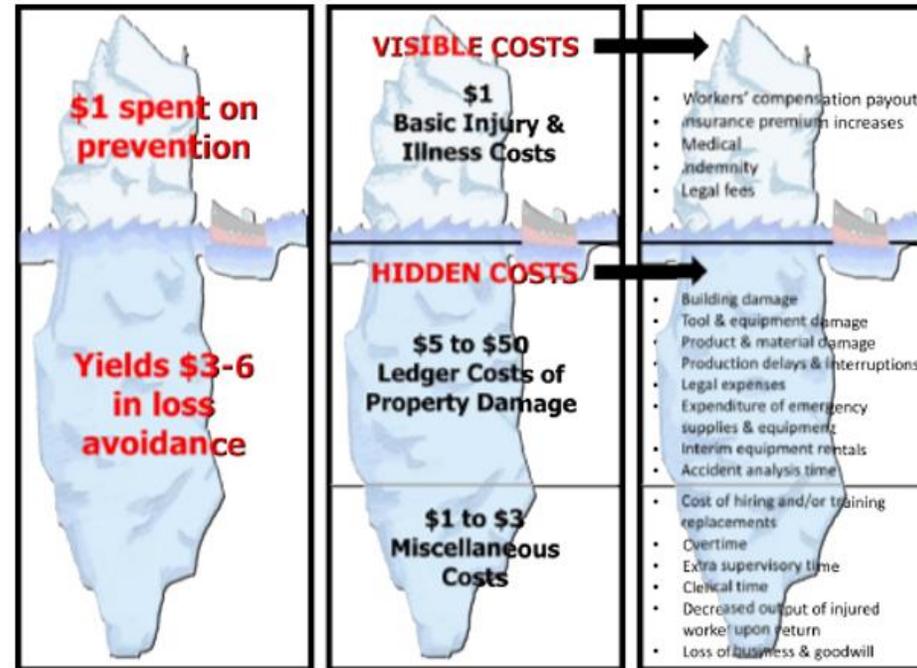
- Near miss reporting
  - Data based decision making
  - Statistical method for continuous improvement
- Unbiased data collection
  - Disparities due to self reporting
- Near miss reporting provides ROI
- Not tracking near miss events may actually put an operation at greater risk of litigation in the event of an accident.



# Cost of Accidents and Not Recording Near Misses



## Accident Cost

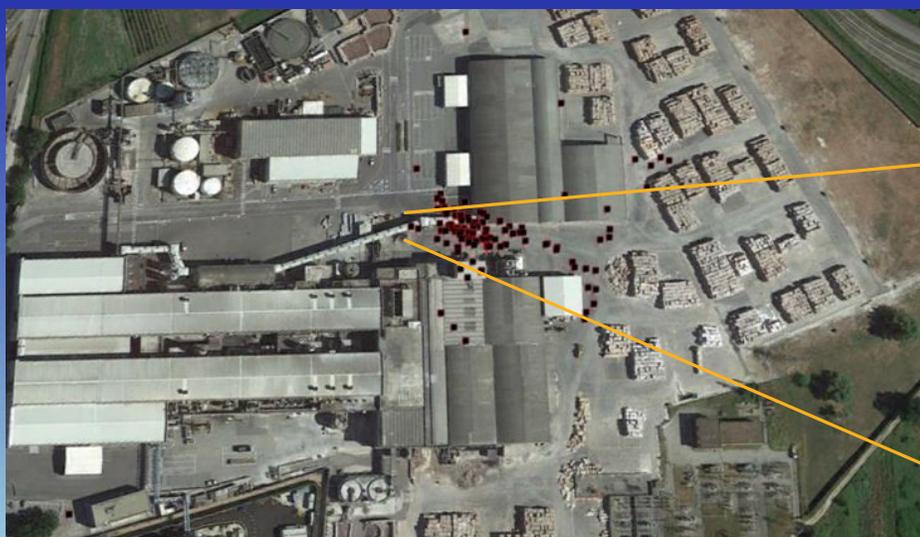


“Grandmas old saying about an ounce of prevention equals a pound of cure”,  
may not be out of place in todays modern business

# Data Examples



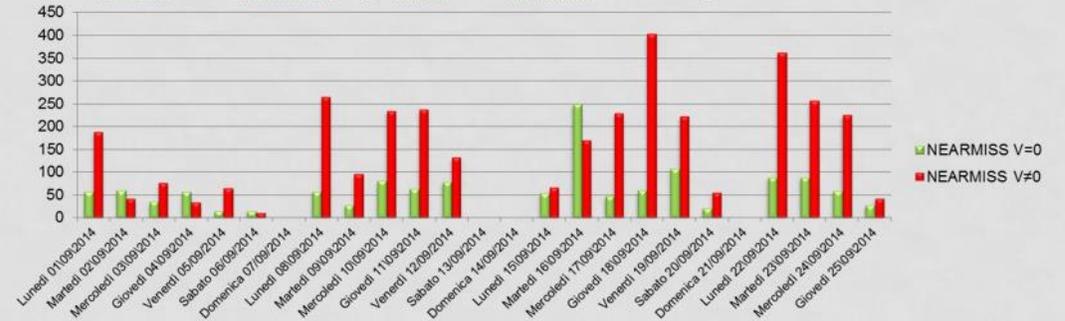
Red = machine in motion Green = Machine stationary



Near miss report was filtered to show events over 15 mph

NEAR MISS	VEHICLE_ID	LOCATION_ID	TAG_ID	SENSOR_ID	TIME-DATA	SPEED	LATITUDINE	LONGITUDINE
58171	18	4	59	8	"2014-09-01 08:12:18.727"	0	43.8236189666667	10.60442145

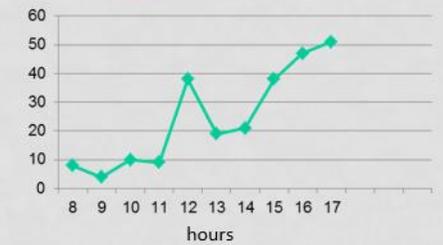
Near miss number by day with speed=0 and speed≠0



Near miss by speed



Near miss by hours



Reports types shown were developed as a result of system captured data – custom

# Conclusion

- Haulage accidents are a reality in this industry.
- While haulage accidents contribute to a small portion of the Lost Time Events , haulage accidents are the highest cause of fatalities.
- Most but not all haulage accidents do not occur while backing up.
- Many different technologies are available to fit every worksite situation and safety culture.
- Technology has improved dramatically since the initial NIOSH studies.
- Preventing accidents without recording near miss events is only a partial solution at best.

