Characterization of Haul Truck Health and Safety Issues

Pilot Project

Haul trucks are a major health and safety concern

What is the Problem?

Powered Haulage…

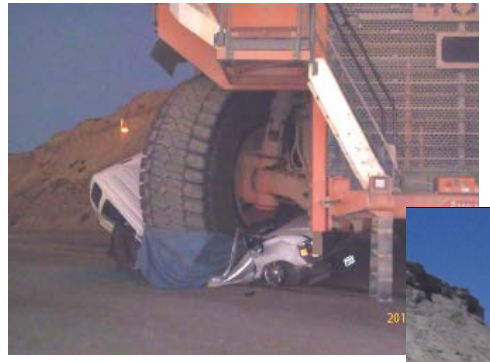
- 50% Fatalities in 2017
- 57% Fatalities in 2018 (so far)

From 1995 – 2014…

- 152 Haul Truck Related deaths
  - 42% Loss of Control
  - 11% Berming

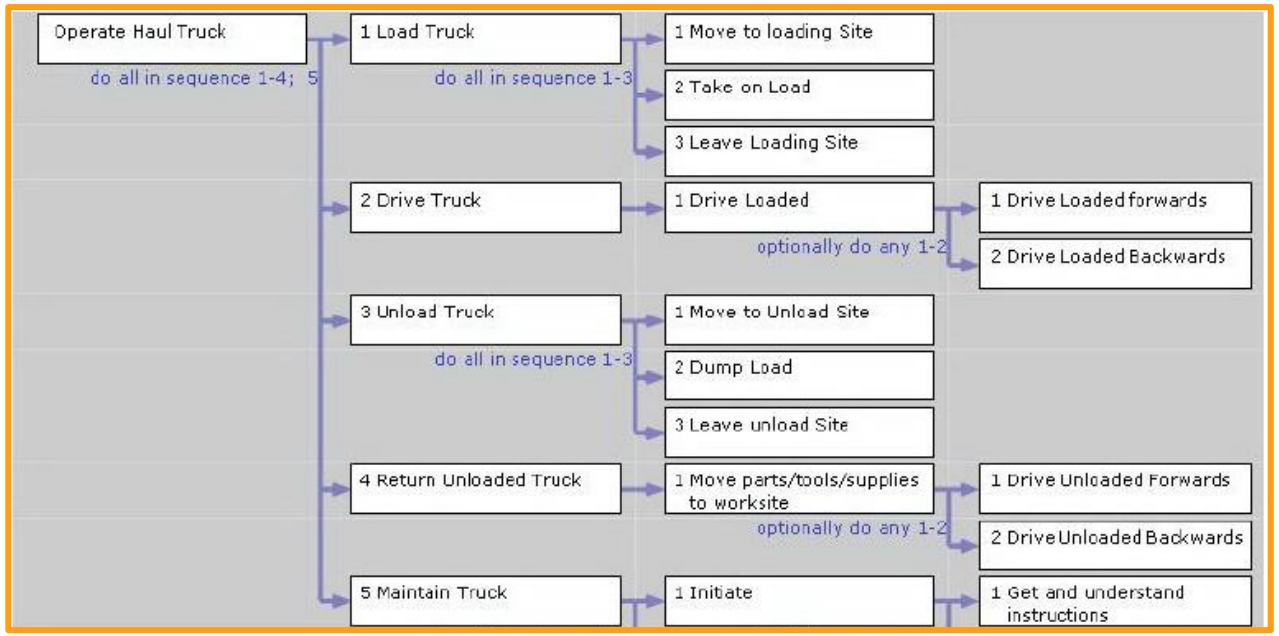
How many people would this effect?

- 45% of all Mining Equipment
- 44,500 active trucks worldwide



Previous Research

Hierarchical Task Analysis



Root Cause Analysis

Causes → Preventative controls → Initiating event → Mitigating controls → Consequence

Objective

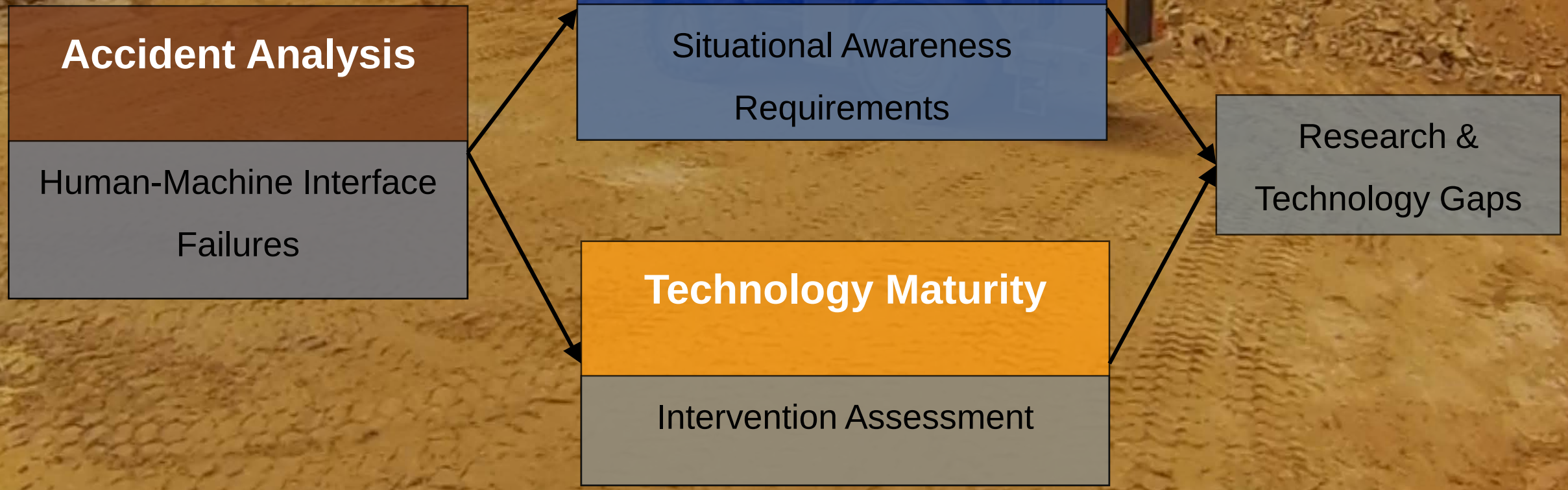
Identify and characterize health and safety issues related to surface mobile equipment through a systematic evaluation of:

1. Accidents and injuries
2. Operators' perspectives
3. Technology maturity

Specific Aim

Identify and characterize health and safety issues related to haul trucks.

Mixed methods project design



Collision Avoidance

Fatigue

Dispatch

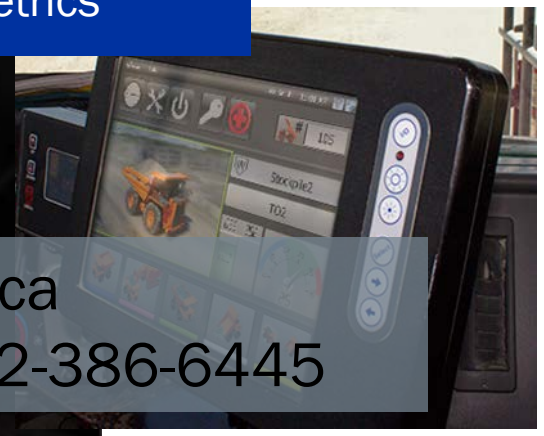
Hazards

Questions?

Navigation

Legacy Systems

Metrics



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Conveyor Safety Project – Automation and Technology Team

MSHA DRIVERS:

2018 RFI – "**Safety Improvement Technologies for Mobile Equipment at Surface Mines, and for Belt Conveyors at Surface and Underground Mines**"

- Guarding
- Improper LOTO
- Improper crossovers, worker proximity to hazards

2018 Regulation – "**Examinations of Working Places in Metal and Nonmetal Mines**"

- Workplace inspection tools/data archiving
- Competent/certified persons

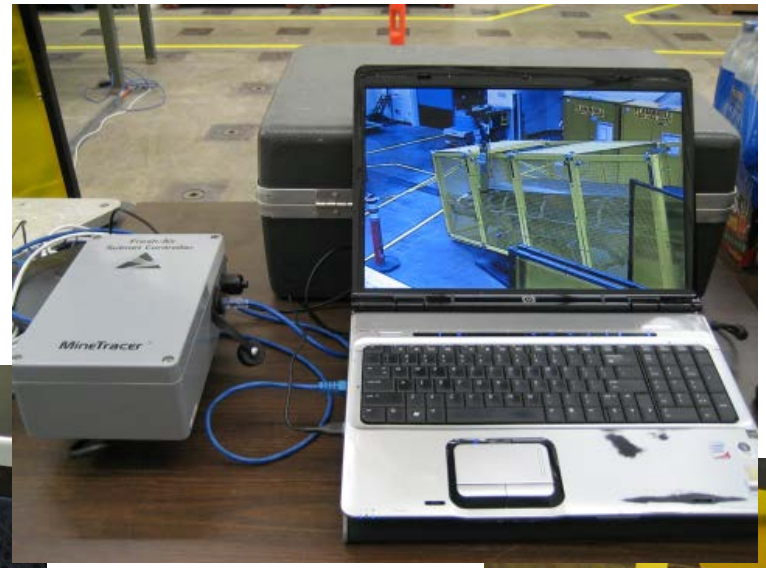
Bottom Line: To reduce fatalities, we will focus on improved methods for:

Inspection, Guarding, LOTO, and Proximity Detection

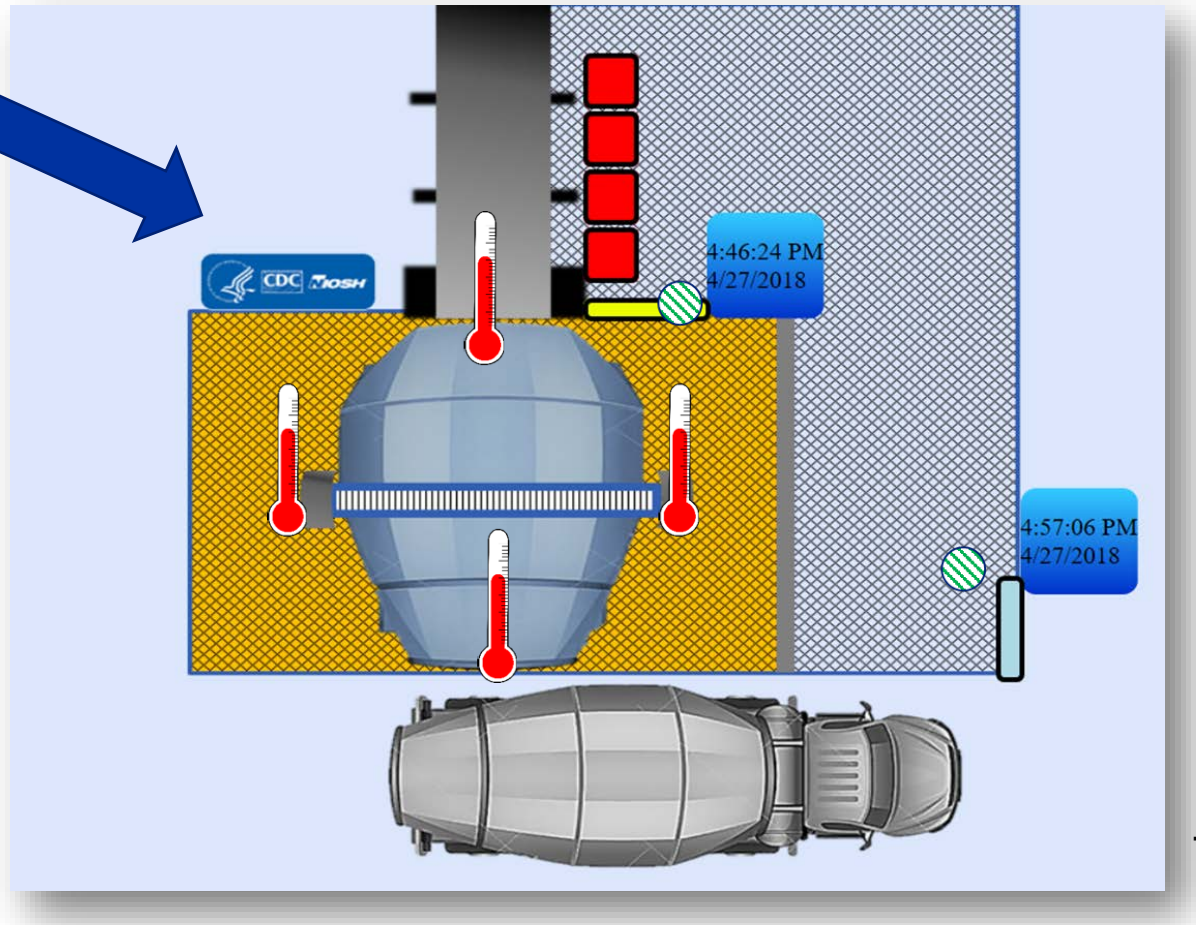
Conveyor Safety Project – Past Work: Guard monitoring

Guard Monitoring

- Proprietary system (Mine Tracer)
  - Guard placement
  - LOTO confirmation



Conveyor Safety Project – Current Work: IoT monitoring system



Lockout Verification

Restricted Access

Bearing/Mix Temperature

iFund Project – IoT demo

- Web-based interface (HMI/cell)
  - Situational awareness
  - Workplace inspection
  - Maintenance planning
- Mesh network and sensors
  - Guarding/proximity/LOTO

Conveyor Safety Project – Future Work: IoT, FMA, Controls, Training

Expand IoT Effort (situational awareness)

- IoT: Field demo with partner
  - Web interface (HMI/cell)
  - Workplace inspection
  - Maintenance planning
  - Guards/proximity/LOTO

Conveyor Safety Tasks

- Failure Mode Analysis
- Engineering controls
  - (Transfer points)
- Training

Conveyor Safety Project – Future Work: Developing tools/interventions

Failure Mode Analysis- big data

- Historical data from sensors (LOTO, Guarding, Bearings, Idlers)
- Personnel task history
- Threshold/alarm events with time stamps

Engineering controls to reduce cleanup

- Root cause - identify high risk areas/activities contributing to conveyor accidents
- Focus on transfer points, and reducing need for cleanup
  - ✓ Develop/improve technologies to reduce spillage (predictive maintenance, housekeeping)

Training

- Conveyor-safety and LOTO training
- Tailor to industry needs (small operators)
- Monitor training status within IoT system
- Focus on personal immersive training

Bottom Line: Our interventions will prevent injuries and fatalities by:

Utilizing big data, Reducing need for cleanup, Increasing situational awareness