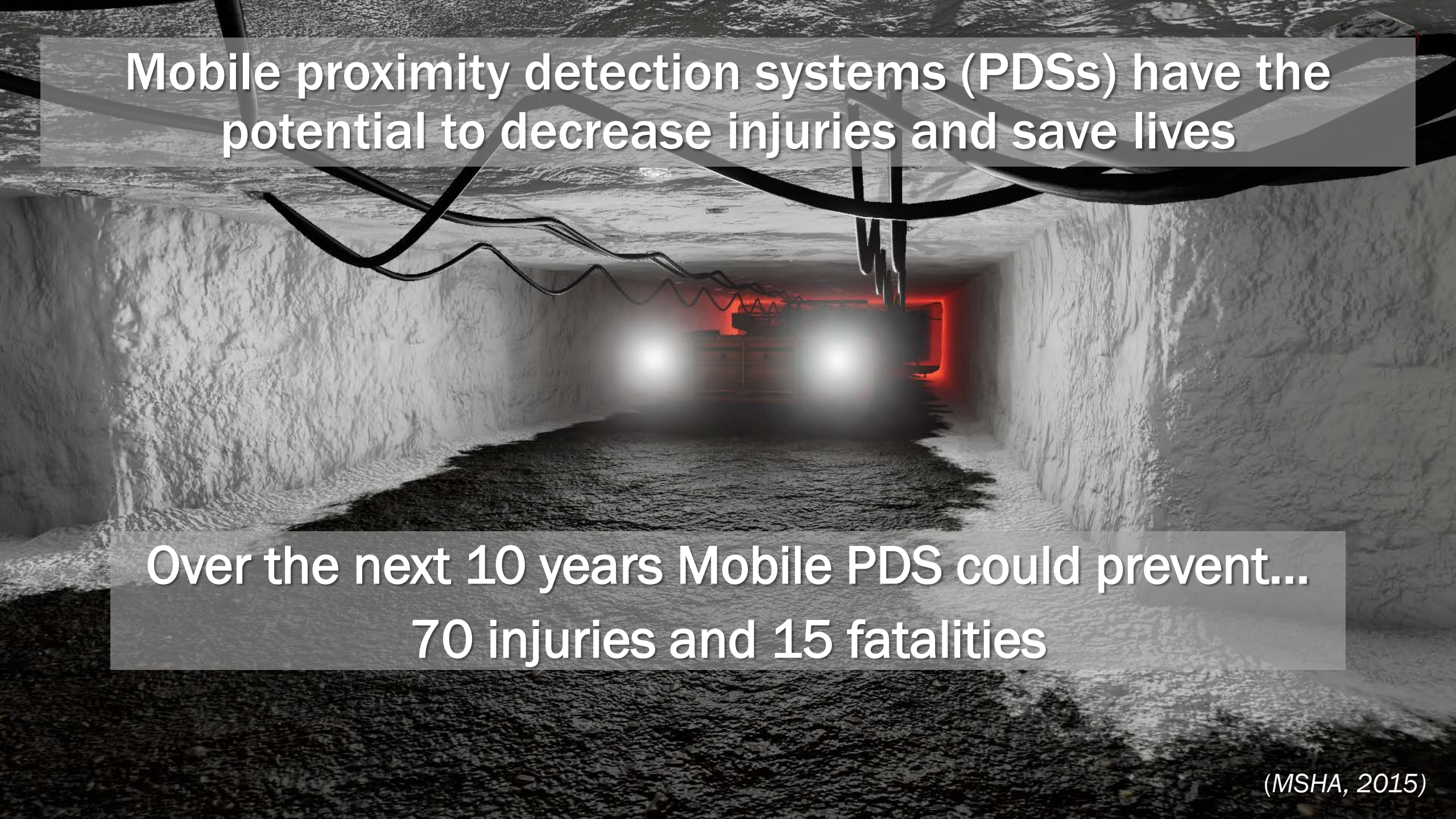
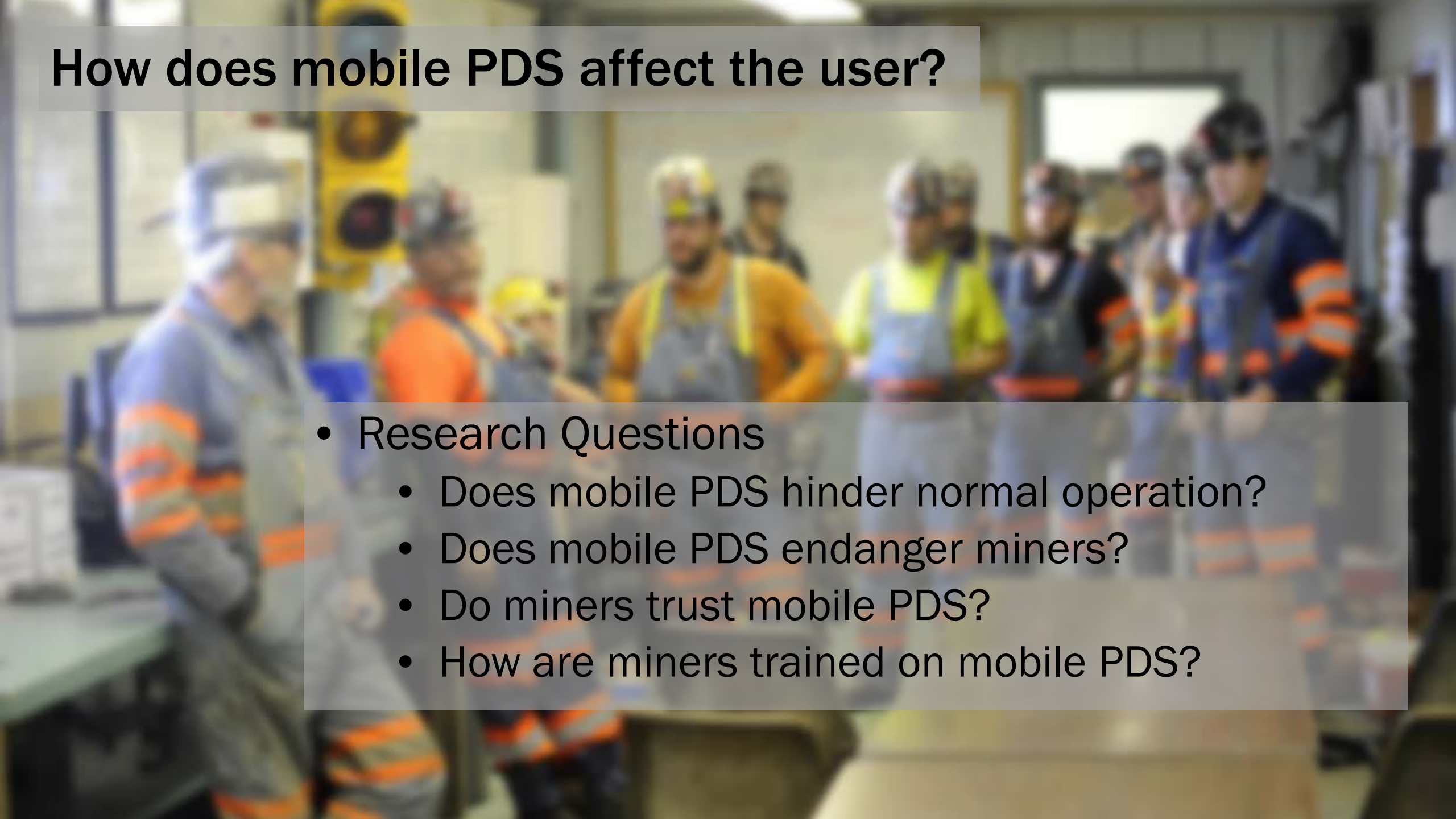


Mobile proximity detection systems (PDSs) have the potential to decrease injuries and save lives

Over the next 10 years Mobile PDS could prevent...
70 injuries and 15 fatalities

(MSHA, 2015)

How does mobile PDS affect the user?



- Research Questions
  - Does mobile PDS hinder normal operation?
  - Does mobile PDS endanger miners?
  - Do miners trust mobile PDS?
  - How are miners trained on mobile PDS?

Mineworker interviews

Data collection

- 5 – 10 Minute Interviews

Participants

- 7 Mines (of 12 possible)
- 223 Individuals

Production Crew	Maintenance Crew
Mobile Equipment Operator	Mobile Equipment Operator
Continuous Miner Operator	Maintenance Worker
Section Foreman	Section Foreman

Mobile PDS implementation

- 1 Mine with full implementation on haulage
- 0 Mines with full implementation on scoops
- Implementation has decreased since MSHA survey (2015)

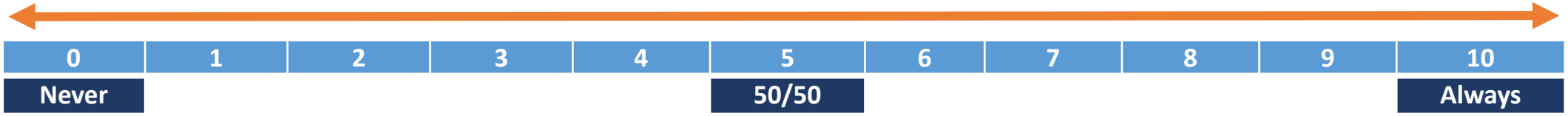
Mineworker interview questions

Usability

1. What do you like about your mobile PDS?
2. What don't you like about your mobile PDS?
3. Can you imagine a situation where your mobile PDS could put you in danger?
4. What would you change about your mobile PDS?
5. How did you learn how to use your mobile PDS?

Trust

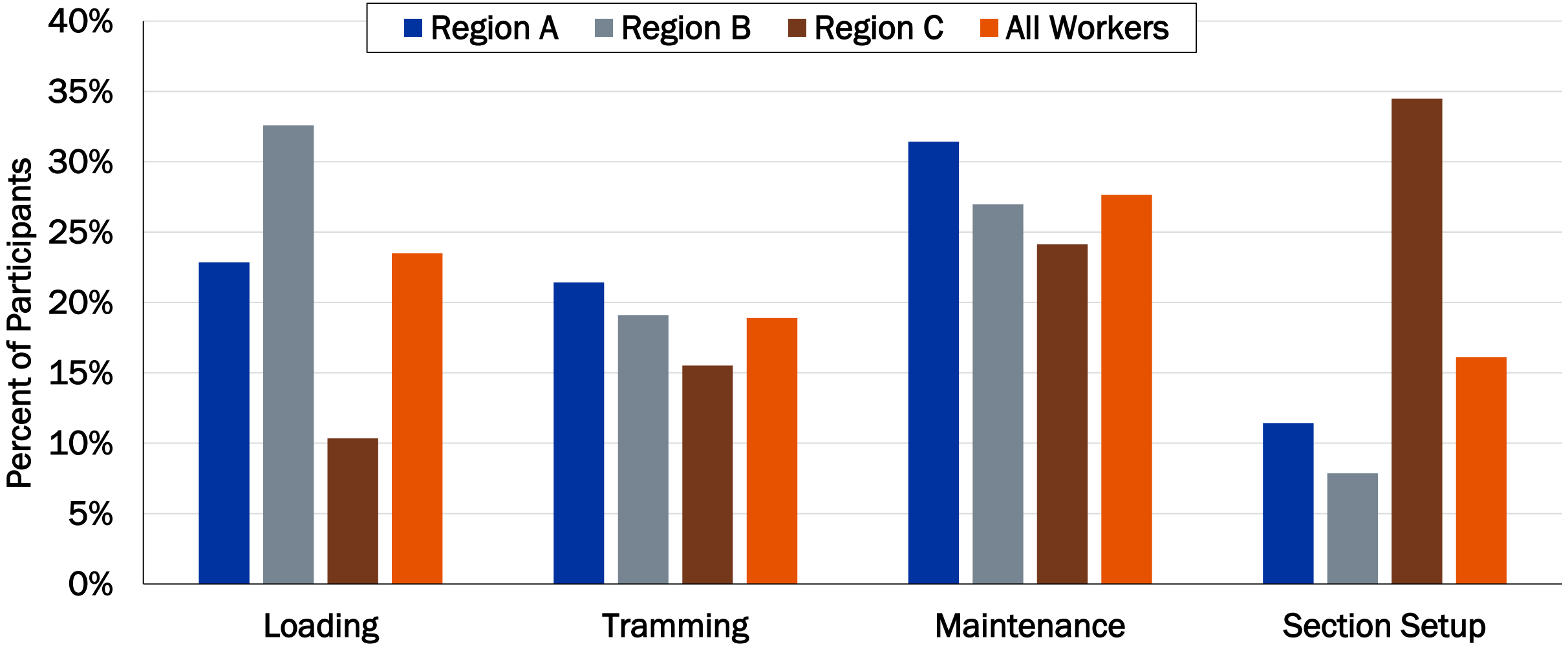
1. How confident are you that the system will prevent a collision?
2. Overall, how confident are you in this mobile PDS?



Are there any unintended consequences of mobile PDS?

Does mobile PDS hinder normal operation?
Does mobile PDS endanger miners?

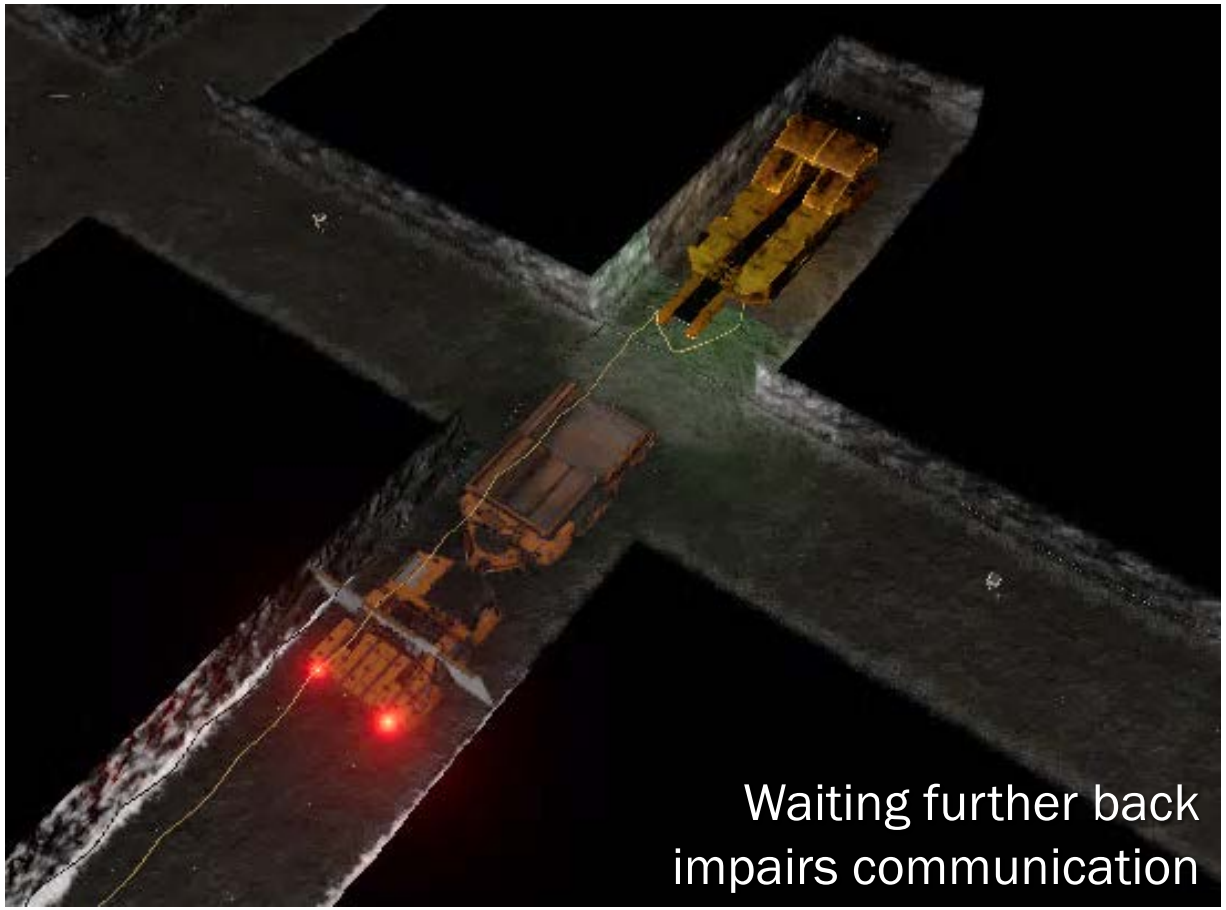
Mineworkers indicated that mobile PDSs predominately affected four mining tasks

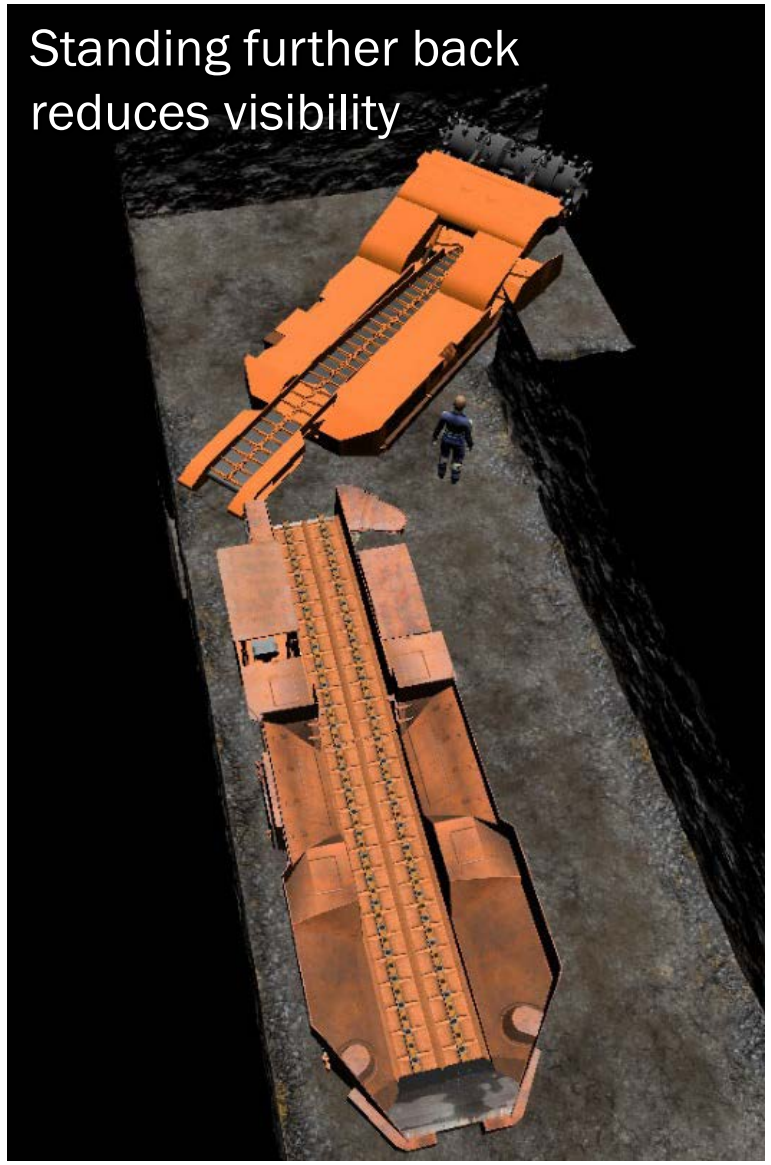


*East, West, Illinois Basin Geographic Regions

Task compatibility: concerns about changes in information availability

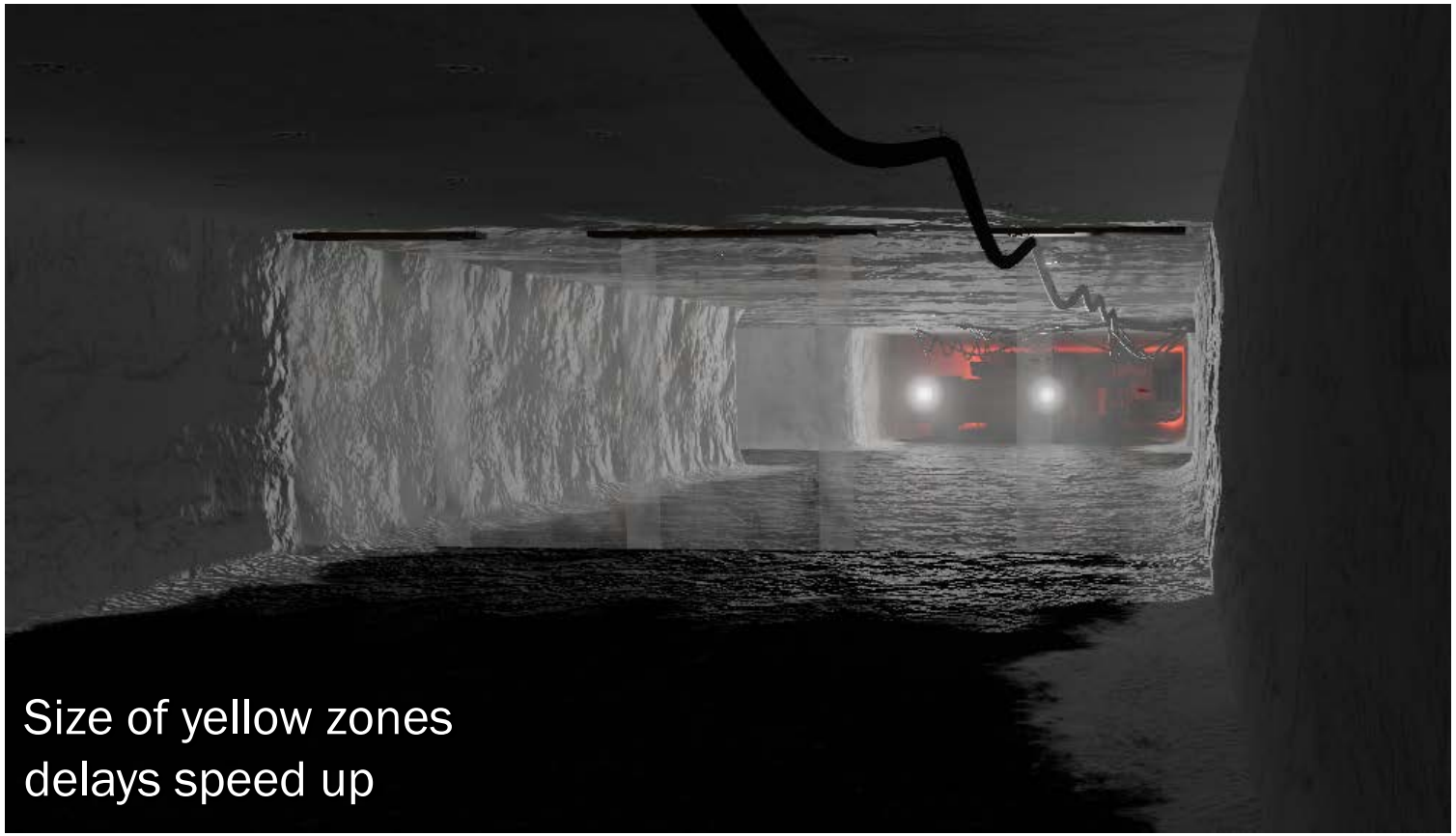
- Reduces visibility
- Impairs communication
- Limits machine accessibility

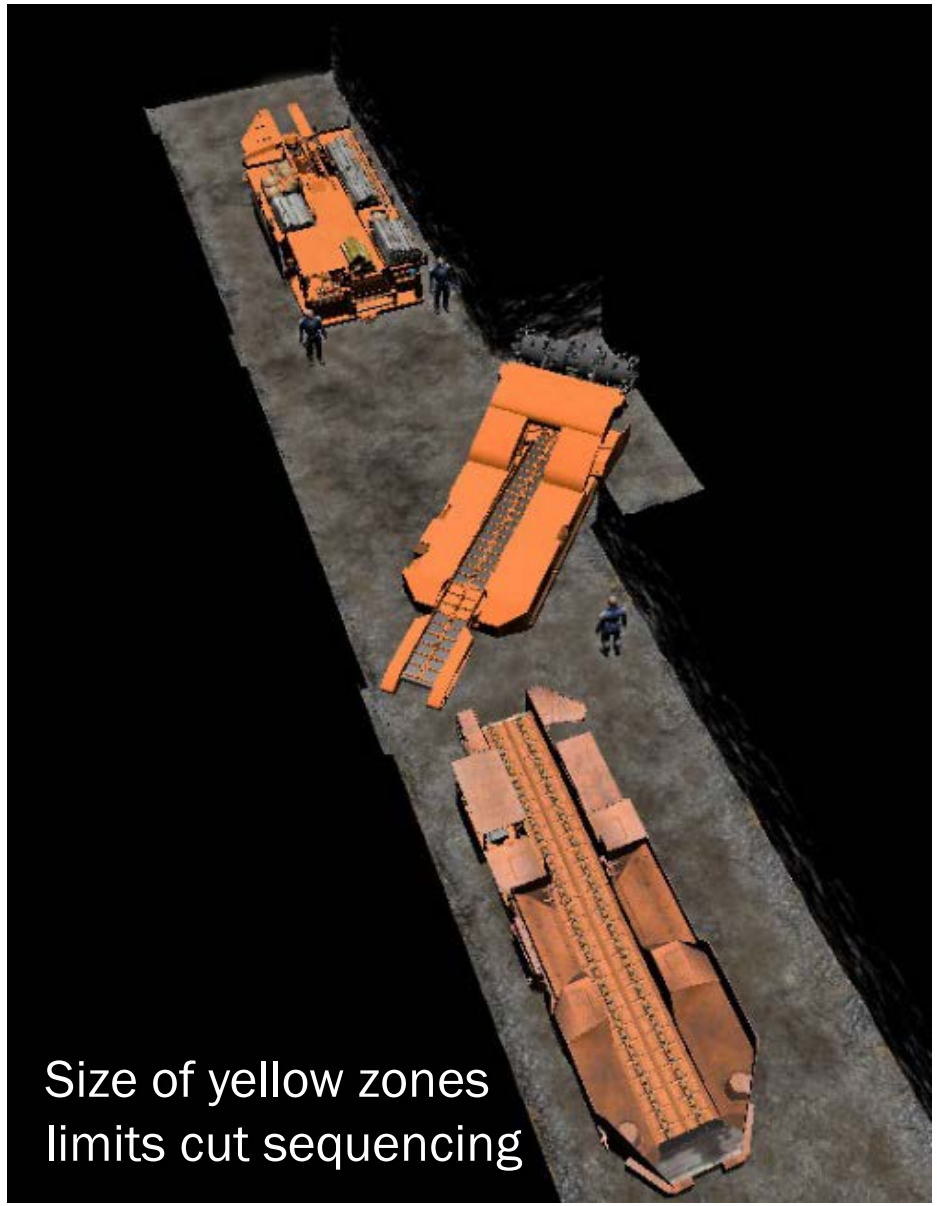




Task compatibility: concerns about reduction in task flexibility

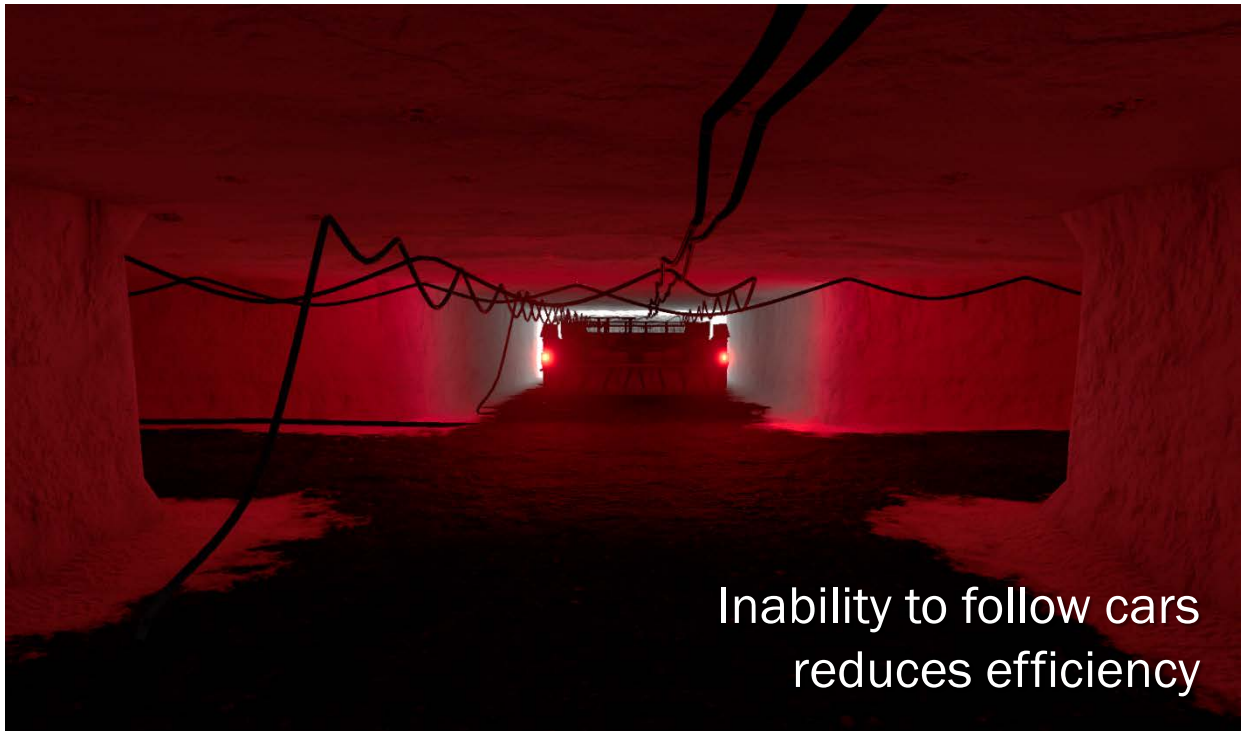
- Reduces adaptability / mobility
- Reduces control





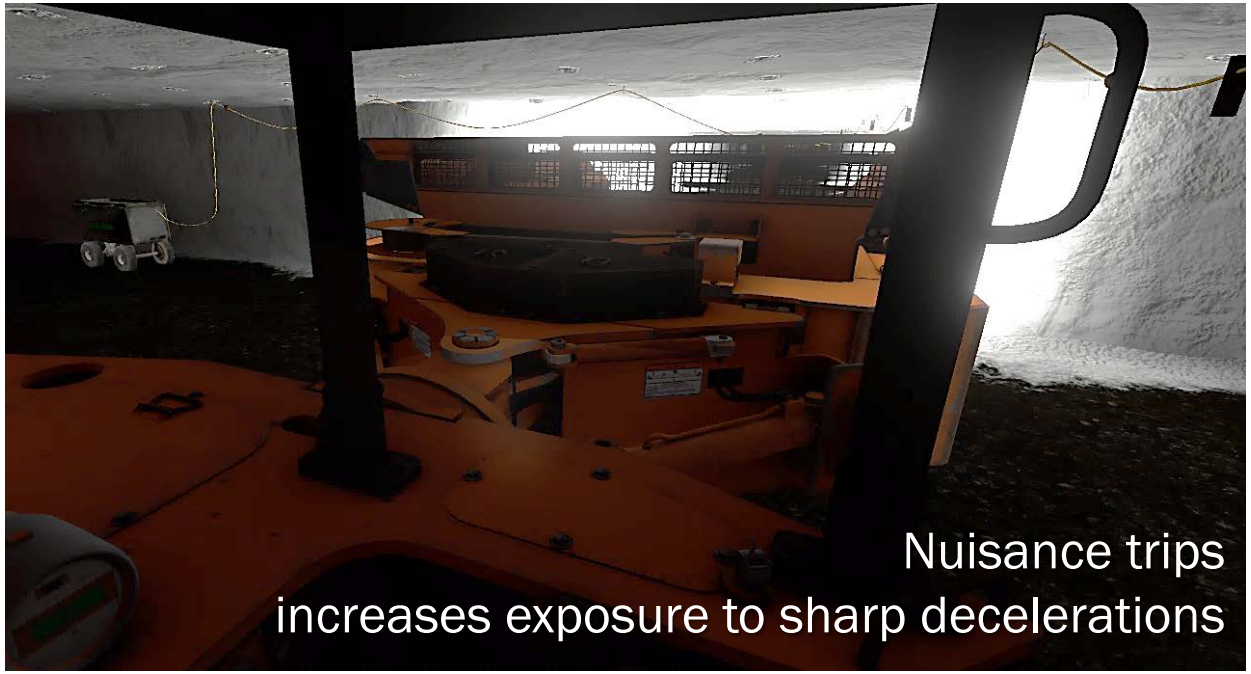
Task compatibility: concerns about increases in time and resources required

- Increases cost
- Reduces efficiency
- Requires additional training



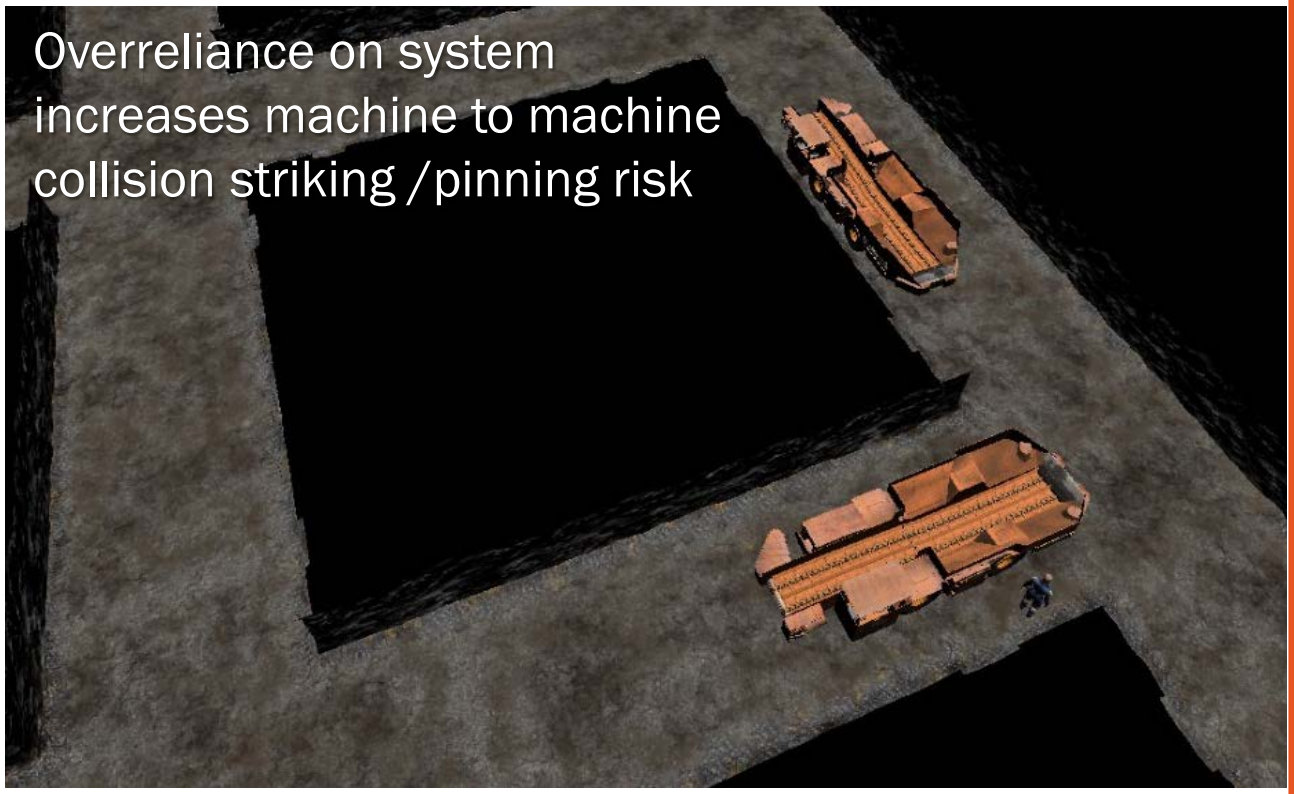
Unintended consequences: concerns about increase in cumulative physical exposure

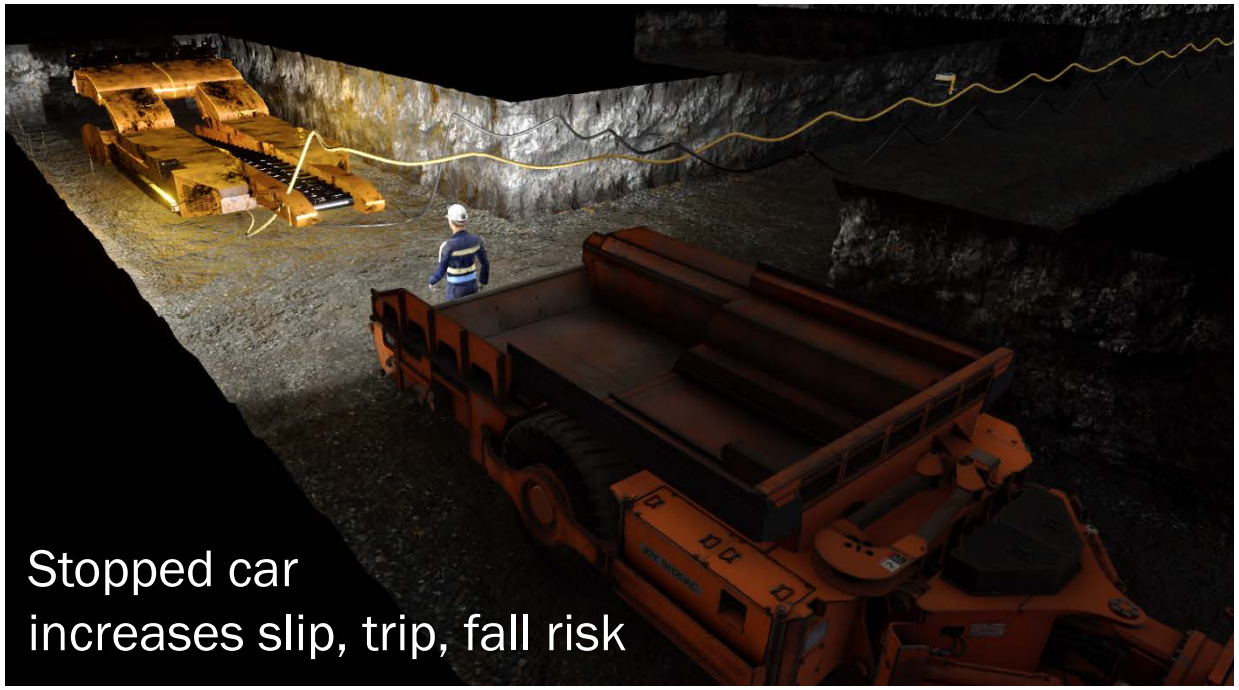
- Increases walking
- Increases manual handling
- Increases jarring / shock



Unintended consequences: concerns about increase of traumatic injury risk

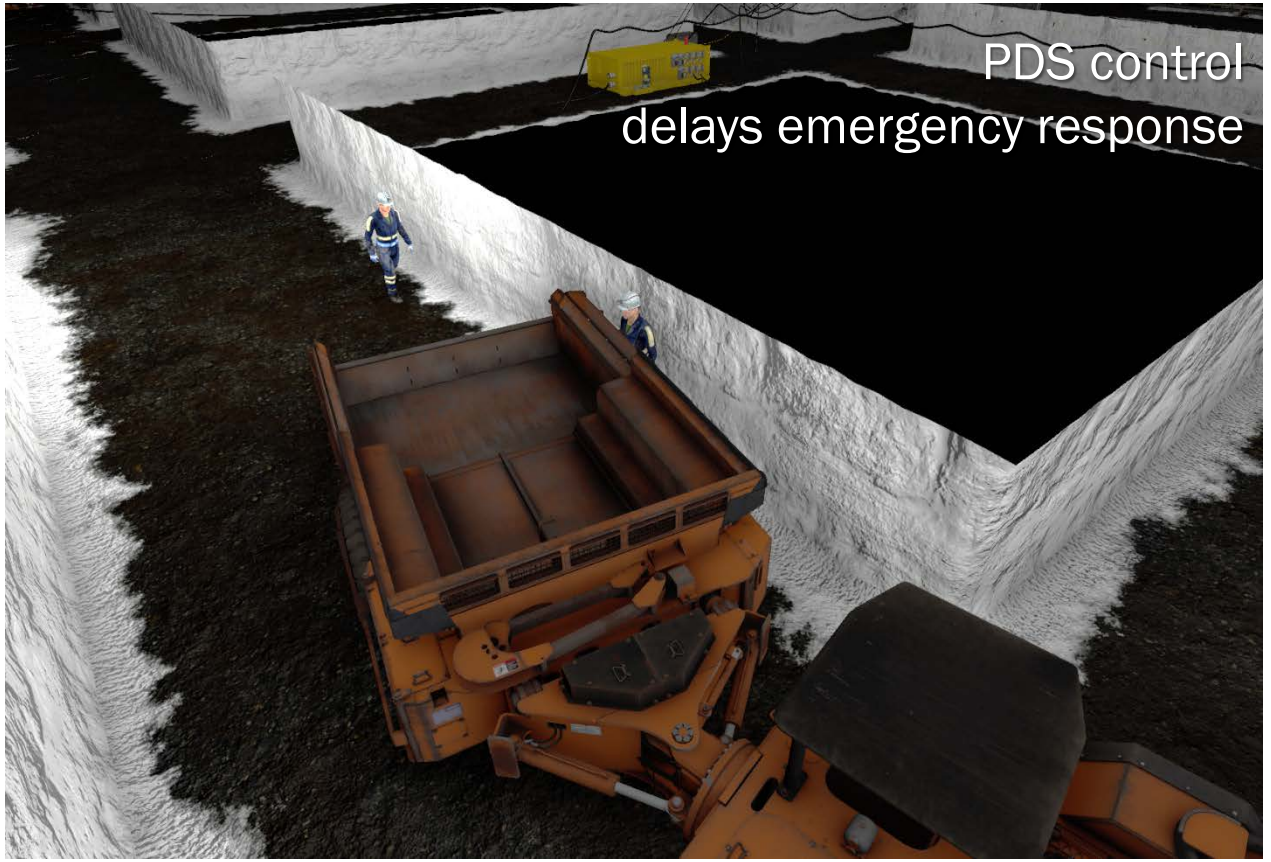
- Increases Striking/Pinning Risk
- Increases Entanglement Risk
- Increases Rib/Roof Fall Risk
- Increases Slip, Trip, and Fall Risk





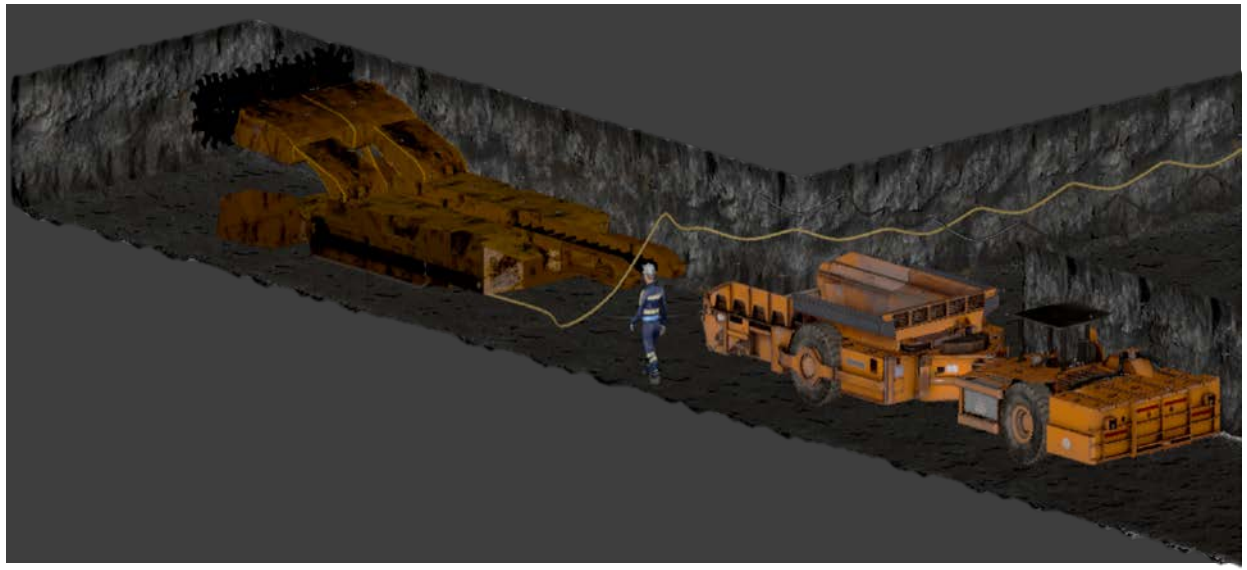
Unintended consequences: concerns about interference with emergency response

- Limits Escape Route
- Prioritizes Pedestrian in an Emergency



Considerations for implementation of mobile PDS

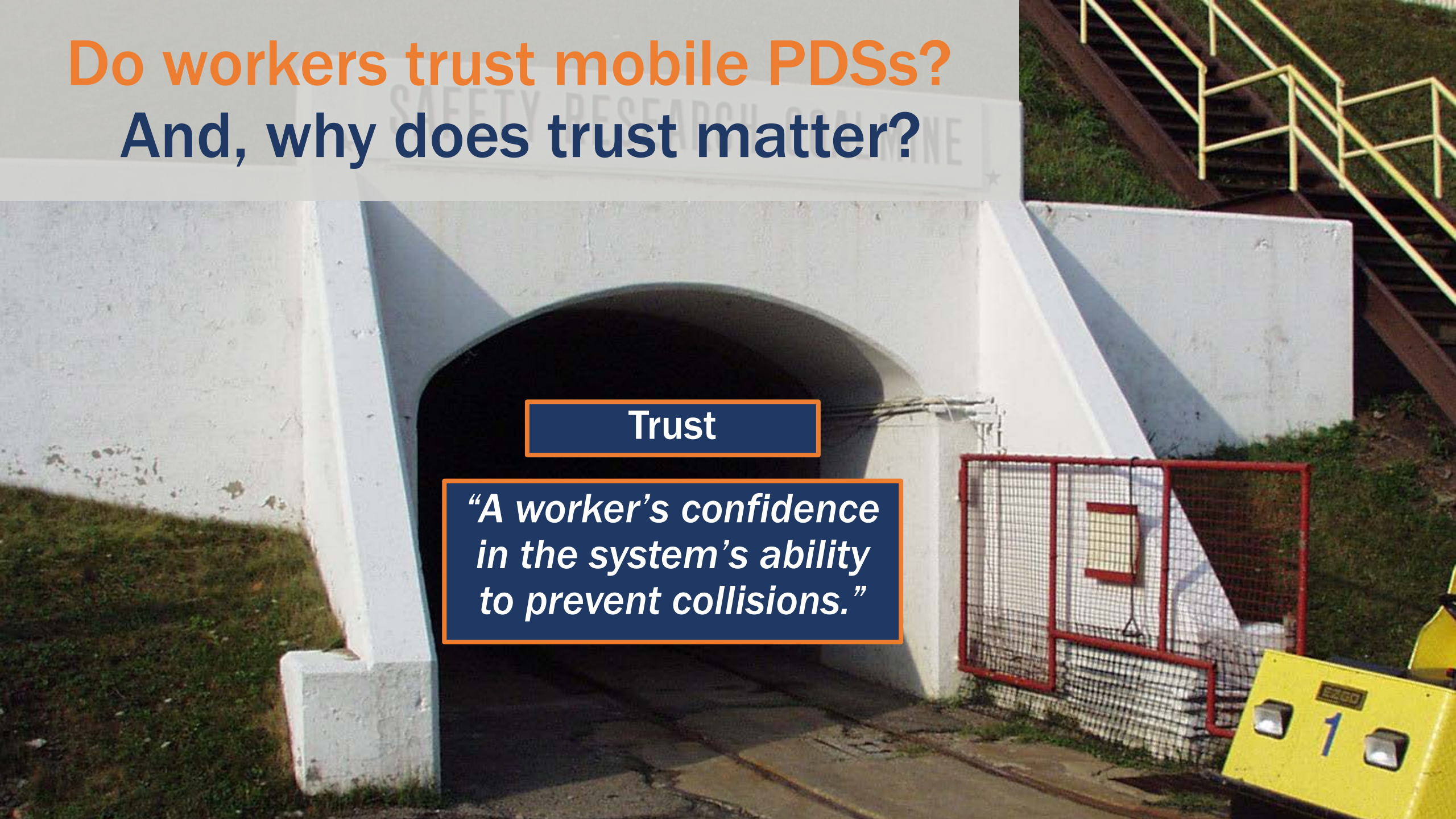
- Mineworkers expressed a need for
  - Improved performance
  - Improved logistics
  - Greater compatibility
  - Additional training



- Operators and PDS Manufacturers may consider
  - Additional site-specific usability testing
  - Narrowing the scope of mobile PDS application
  - Mitigating task incompatibilities

Do workers trust mobile PDSs?

And, why does trust matter?



Trust

"A worker's confidence in the system's ability to prevent collisions."

Trust can influence the use of mobile PDSs and overall safety

Misuse

- Overreliance
- Excessive trust

- Example:
  Relying on system when there is electromagnetic interference

Disuse

- Underutilization
- Insufficient trust

- Example:
  Inappropriate use of the override function

(*Parasuraman & Riley, 1997*)

Previous research identified factors that have influenced trust

Experience

System-specific experience increases trust

General experience decreases trust

Sheridan & Hennessy, 1984; Sanchez et al., 2014

Age

Older adults over-rely on technology

Older adults mistrust technology

Johnson et al., 2004; Fletcher & Jensen, 2015

Mine

Culture & organizational factors influences trust

Baba, et al., 1996
Kramer, 1999

System

System reliability and performance increases trust

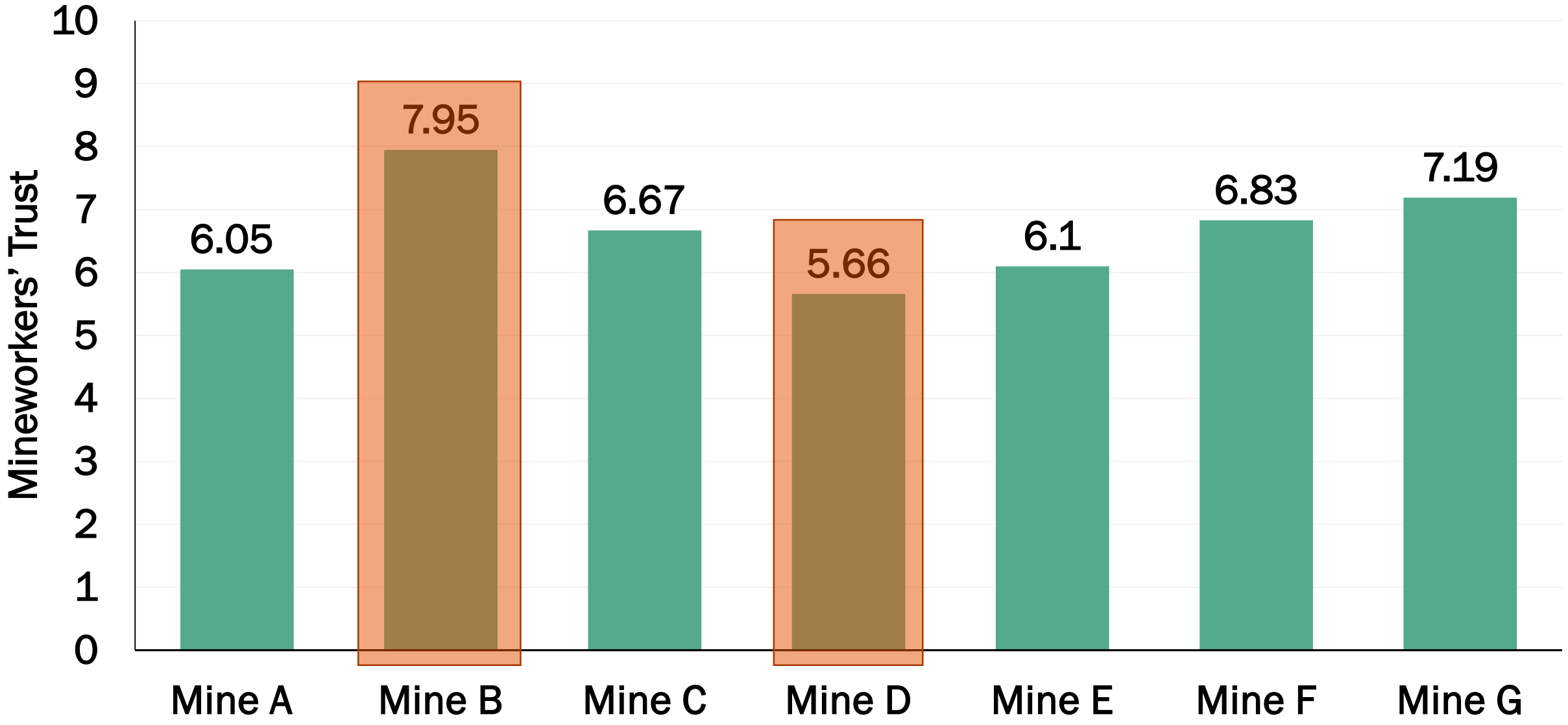
Lee & Moray, 1992

Training

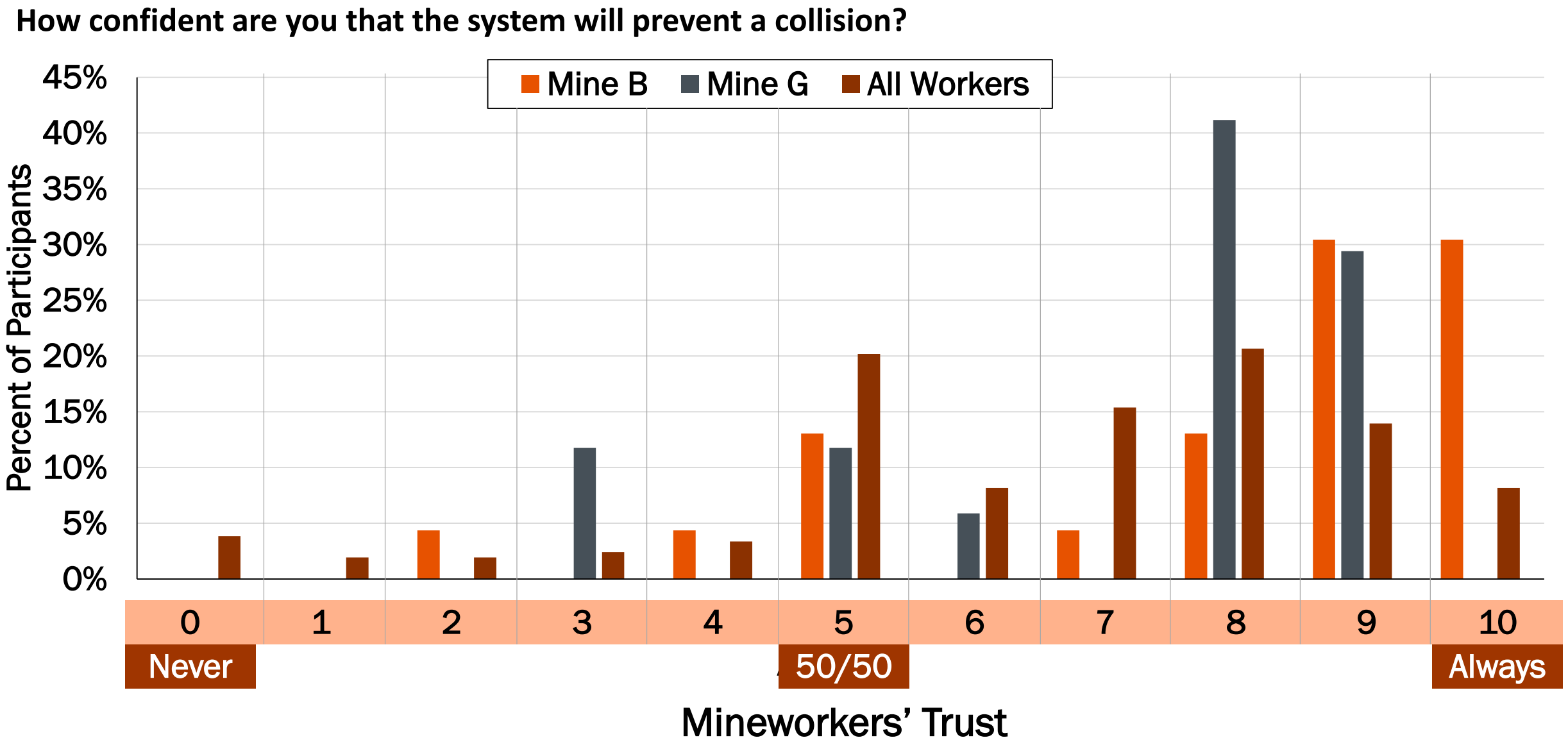
Increases trust

Cohen, 1998

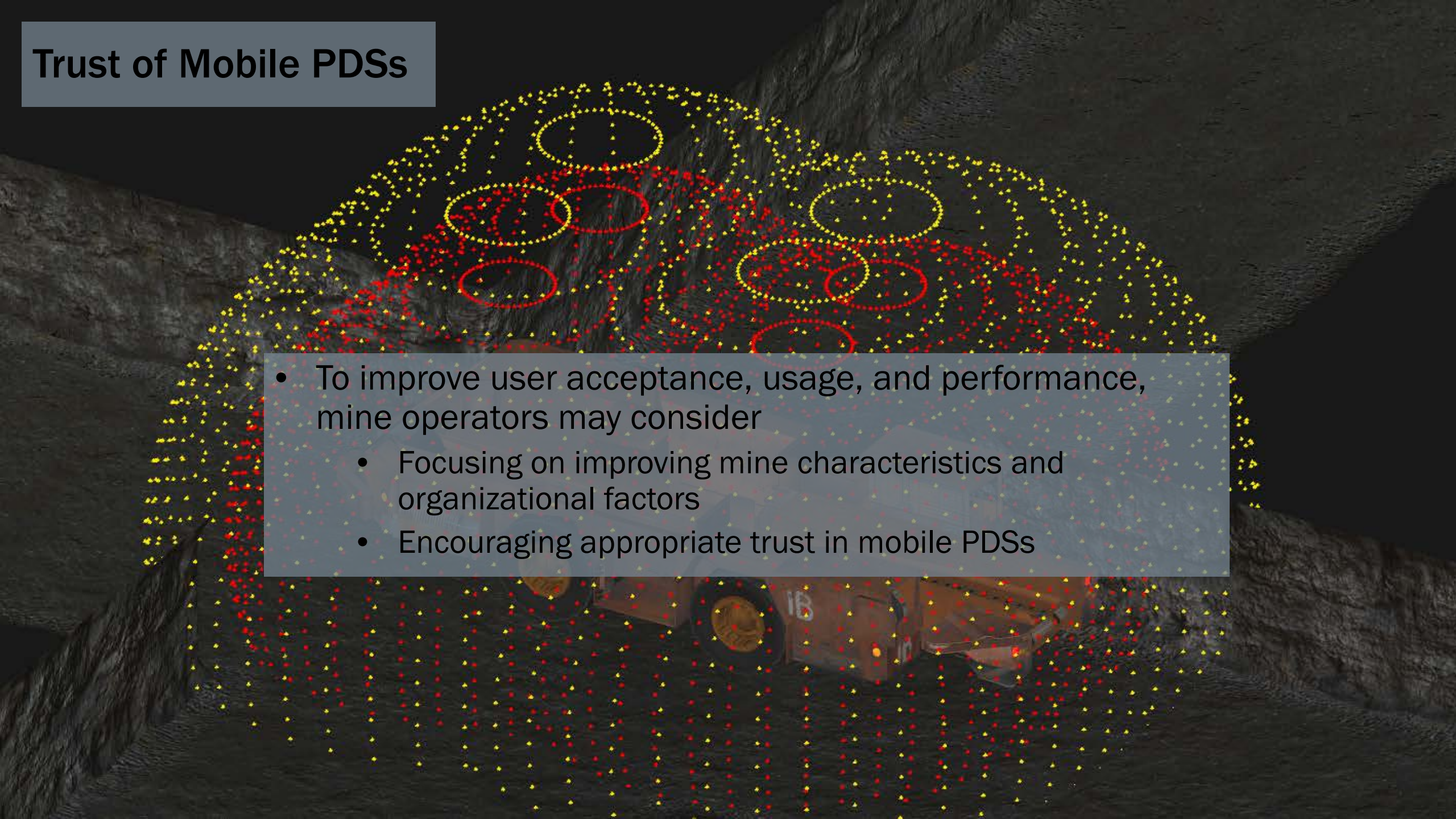
Mine was the only significant factor affecting trust



Despite moderate means, trust levels vary by individual at each mine site



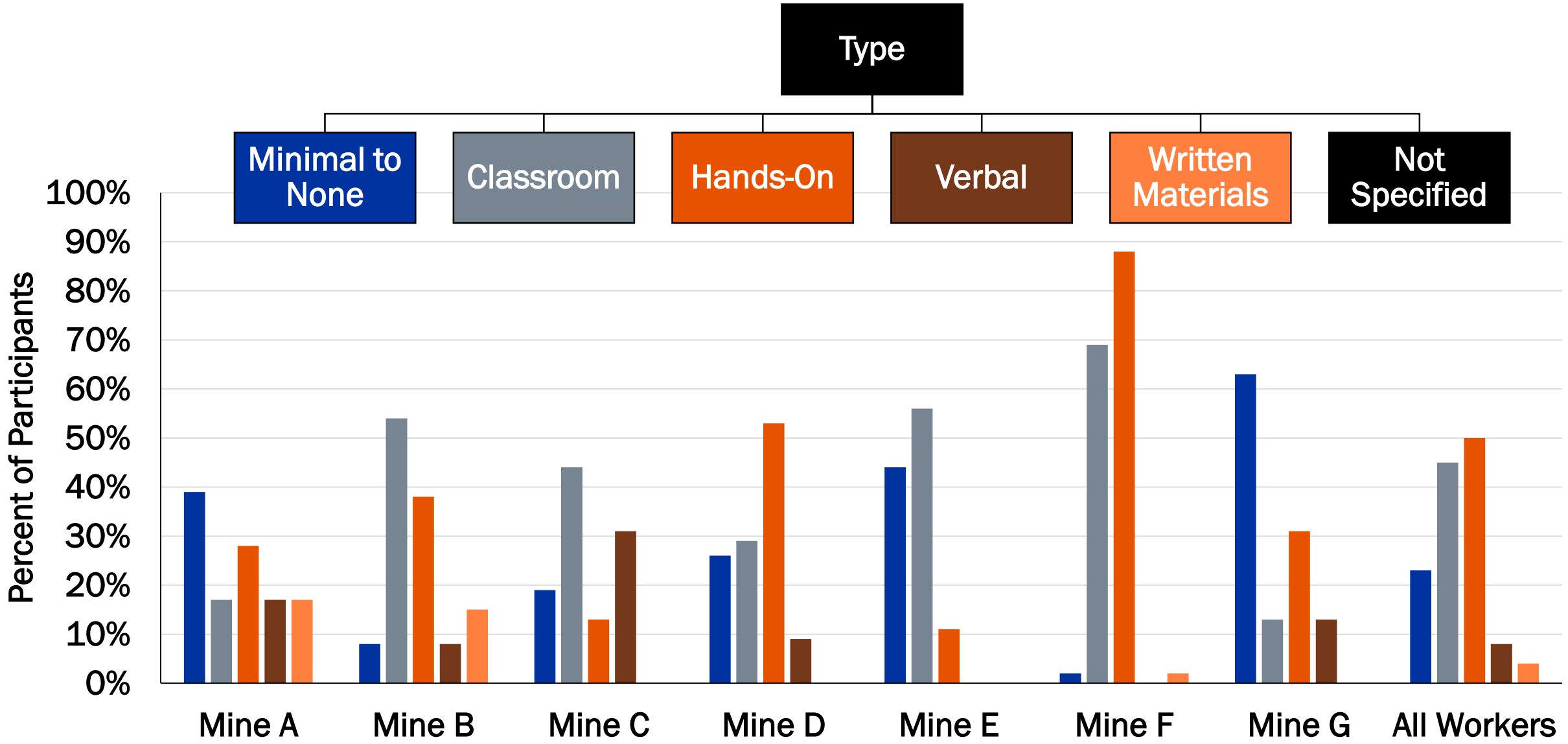
Trust of Mobile PDSs



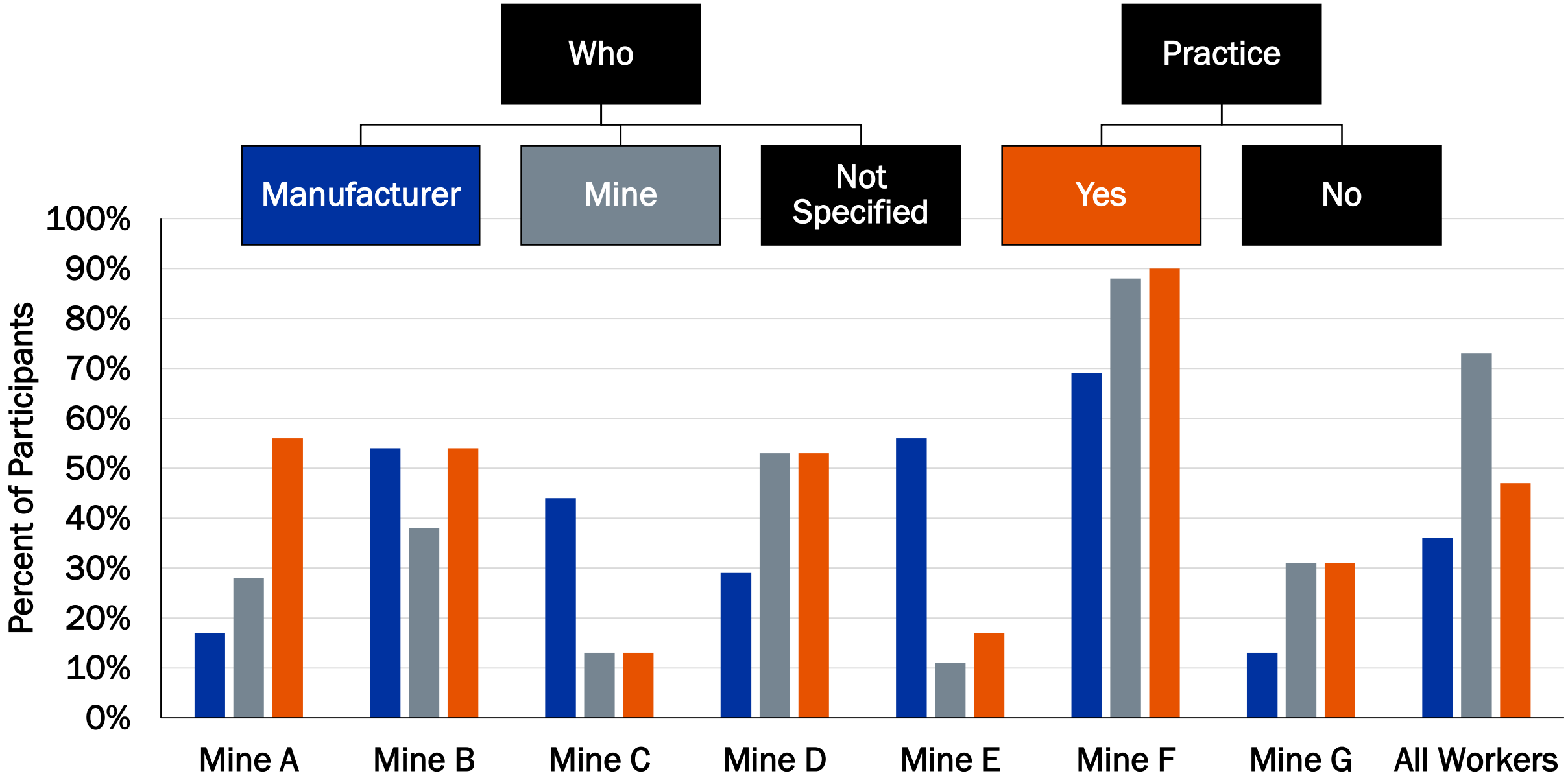
- To improve user acceptance, usage, and performance, mine operators may consider
  - Focusing on improving mine characteristics and organizational factors
  - Encouraging appropriate trust in mobile PDSs

How are mineworkers trained on mobile PDS?

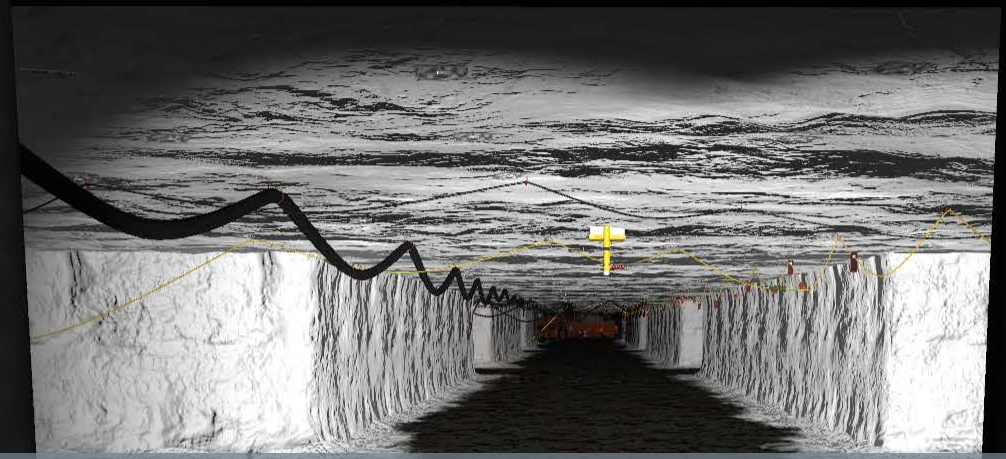
Most mineworkers reported receiving classroom & hands-on training
Many mineworkers reported receiving minimal to no training



Most mineworkers reported being trained by the mine including practice



User perspectives can help identify improvement opportunities



- Operators and PDS Manufacturers may consider
  - Mitigating task incompatibilities
  - Mitigating unintended consequences
  - Encouraging appropriate trust
  - Ensuring mineworkers receive engaging, informative training

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