

# MINING AUTOMATION

A Global Perspective – A preliminary report  
NIOSH Funded Research

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# OUTLINE

- Introduction
- Mines visited
- Equipment evaluated
- Skill development
- Acceptance
- Complacency – Cultural Differences
- Distributed Situational Awareness
- HMI
- Productivity/Safety-related trends

# INTRODUCTION

- 3-Year Project to determine the path of development of the automation transition in countries more advanced in the transition than we are here in the United States.
- Project involved;
  - Observing the operations of many companies in several countries;
  - Interviewing workers, engineers and management representatives using semi-structured interview process involving a base of 13 questions;
  - Researching production, operational and safety performance data

# MINES AND COUNTRIES VISITED AND INTERVIEWS HELD:

- Surface coal (2) – Australia
- Underground coal – Australia
- Underground iron ore – Sweden
- Underground gold, silver, lead and zinc – Alaska USA
- Surface copper – Chile
- Surface iron ore (2) and platinum - South Africa
- Surface iron ore – Brazil
- Surface Diamond - Botswana
- Oil Sands - Canada

# AUTOMATED OR REMOTELY OPERATED EQUIPMENT EVALUATED

- Haul Trucks (autonomous)
- Dozers (autonomous and remote operation)
- Drilling machines (remote operation)
- Loaders (remote and autonomous operation)
- Longwall shear and shield (automated but supervised from a control room)
- Underground haulage trains (automated but supervised from a control room)

# IMPACT ON WORKER SKILLS

- No one has involuntarily lost their job due to automation.
- Jobs have changed
- People have to learn new skills and use higher order thinking to accomplish higher order tasks
- “We used to be just miners, but now we are so much more!”  
(Quote – underground miner – May 2022)
- However, not everyone is willing to change. Transition may be able to rely on attrition.....it is natural and will occur.



# SKILL DEVELOPMENT – SKILL GAP?

- Reported that for every manual position lost, within the automated system, two or three are needed.
- Fear that there will not be enough people available for the higher order thinking roles
- Necessary changes:
  - Controllers and other operational positions
  - Maintenance
  - Programmers
  - Communication systems
  - Cyber security

# ACCEPTANCE

- Acceptance by the workforce is critical to success of an automated system. (Chilean company interviewed for people with a technology-friendly mindset)
- Many suggest that acceptance is driven by the organizational culture?
- There does not appear to be resistance in Sweden or Chile
- East vs. West (cultural – Australia and US – widespread resistance)
- Commodity differences (cultural – Australia and US)
- Age-related differences (Sweden and Australia)



## OTHER ISSUES TO ADDRESS

- Complacency and loss of Situational Awareness
- Distributed Situational Awareness
- Human-Machine Interface

# PRODUCTIVITY/SAFETY-RELATED TRENDS

- Productivity improvements have not been significant yet (attributed to newness or still learning).
- Some maintenance cost reductions have been reported – e.g., haul truck tire life has doubled from 5,000 hours to 10,000 hours
- Overall 30-35% reduction in injuries has been reported by one company.
- Another - there have been no injuries attributed to the automation.
- Another - there has been no increase in injuries since the transition.
- Anecdotal evidence reported - fewer back injuries and musculo-skeletal injuries.

# PRODUCTIVITY/SAFETY-RELATED TRENDS

- Productivity is expected to improve as people become more skilled in planning, running and maintaining the operation.
- Currently equipment speed and loading capacity are considerations (40 tons to 25 tons).
- Widespread expectation for lower maintenance costs.

# WHERE TO FROM HERE?

- There is more to learn.
- More experience to be gained on all fronts.
- More practice and training to be undertaken to improve productivity.
- Management must understand their organization's culture.
- There is already a significant drop in risk of injury due to there being fewer people in the mine (hazards are still there).
- There is still a significant risk present though as long as automated and manual operations continue to operate jointly in the mine.