Regulatory Issues for Automation in U.S. Mines

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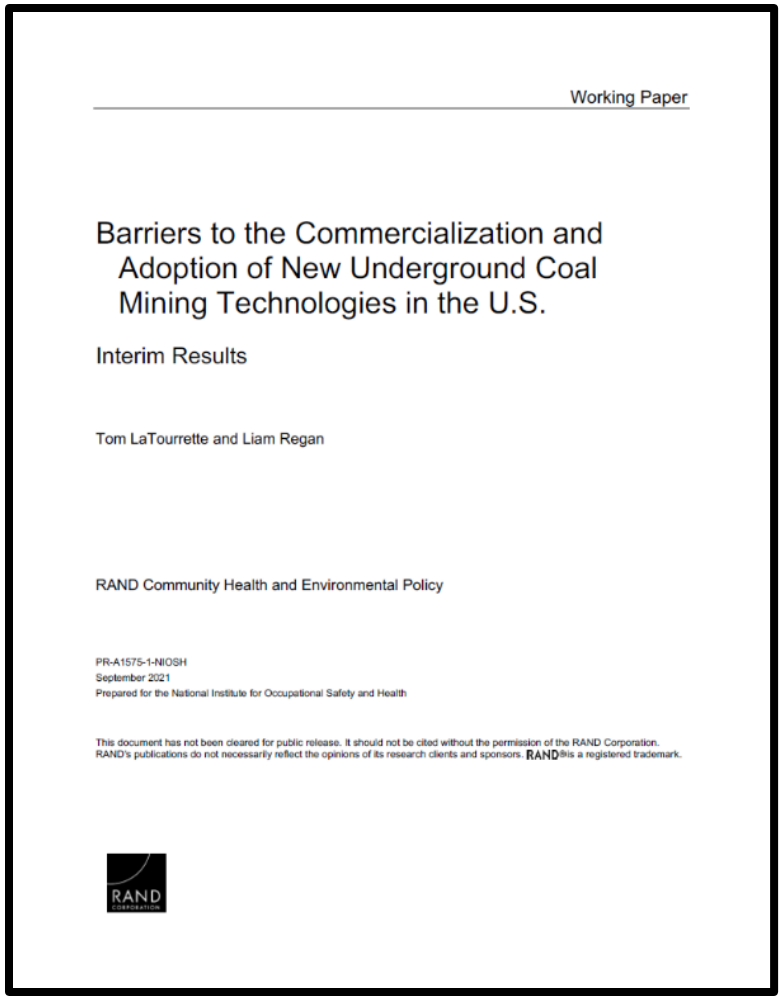
The findings and conclusions in this presentation are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the National Institute for Occupational Safety and Health.

NIOSH Experience with Implementing Safety and Health Technologies in U.S. Mines

MINER Act of 2006 - NIOSH to expedite the implementation of new S&H technologies

- Limited success and many barriers
- NIOSH experience with S&H technologies
  - Automation is a S&H technology
- NIOSH has several efforts related to identifying barriers

RAND Study



Working Paper

Barriers to the Commercialization and Adoption of New Underground Coal Mining Technologies in the U.S.

Interim Results

Tom LaTourrette and Liam Regan

RAND Community Health and Environmental Policy

PR-A1575-1-NIOSH
September 2021
Prepared for the National Institute for Occupational Safety and Health

RAND

This effort was to identify implementation barriers for new technologies in the underground coal mines.

- Blind study conducted by an outside party to ensure objectivity and honest input.
- Interim Report available at this link: https://www.rand.org/pubs/working_papers/WRA1575-1.html
- Workshop was conducted to try to prioritize the barriers, final report to be available at a later date.

Barrier Taxonomy – Groups and Subgroups
24 barriers identified

Economic

- Insufficient Demand (4)
- Insufficient Supply
- Specialized Market

Regulatory

- Approval Costs
- Approval Duration (4)
- Currency of Regulations (2)
- Prescriptiveness of Standards (4)
- Operator Burden (3)
- Regulatory Culture

Other

- Cultural
- Liability
- Federal Support

Note: Number of barriers shown in (-) if greater than one

Regulatory Related Barriers per RAND Study

Top 3 cited regulatory related barriers for introduction of technology:

- Delays in equipment approval.
- MSHA-specific standards isolate U.S. underground coal mining market.
- Prescriptiveness of MSHA regulations.

Equipment Approval and MSHA Specific Standards Barriers

My explanation of problem in simple terms:

> *MSHA equipment approval personnel must try to answer a question that is nearly impossible to answer. If they do successfully answer it, they are more than likely to have answered the wrong question.*

This situation is beyond the control of MSHA personnel and very likely beyond MSHA's ability to change without regulatory or legislative intervention.

Equipment Approval and MSHA Specific Standards Background

Mining law require MSHA to determine that new standards and practices provide "the same measure of protection afforded the miners" compared to current practices.

- Requirement has evolved to the equipment approval people being asked to determine that a device or piece of equipment is as safe as the existing equipment and standards.
- This evaluation is extremely difficult for new technologies considering that regulations were written when equipment was hard-wired and manually controlled.

Equipment Approval Challenge – example

Let's consider a simple hard-wired circuit turned on and off by a person. (This represented the majority of system controls at time the regulations were adopted.)

- Compare this on-off hardwire control to a coax/ethernet/or fiber cable transmitting multiple signals generated by a microprocessor, boosted by amplifiers, and decoded by a receiver, under the control of a central processor or motherboard; all of which are directed by software. How do we compare the safety of one to the other?
- Over the years these comparative efforts of technical parameters have evolved into MSHA specific approval criteria (i.e. approval criteria started as U.L. 1969 electric code)

MSHA Specific Requirements – Where are we now?

Back to the question that MSHA is asked to determine:

How do you determine equivalency when the safety of existing equipment and practices have not been quantified?

- MSHA evaluates equipment relative to the approval criteria and look at every aspect of the equipment.
- If not within the criteria, or more conservative, or not addressed by the criteria; the equipment is rejected, or more information is asked for, or MSHA has to educate themselves and figure out how to deal with it.
- Operator can request a variance through a petition process where the operator must demonstrate equivalency. (“High” Voltage CM, PAPR, Mine Total Station)

MSHA Equipment Approval Determination

Is the miner safer in the context of the overall mine operation by approving/disapproving the equipment? Who knows? That is not the evaluation that was made.

The question they have answered is the wrong one.

- The question that should be answered is whether or not the new equipment (or alternative method) will reduce the safety and health risks for the miner overall.

What about a quantitative risk based regulatory framework?

What about a risk based regulatory framework?

What if the mining regulation said “Level of protection afforded the miner is equivalent to existing standards and practices or a Safety Integrity Level of X, whichever is less.” ?

- May allow new approaches that can be determined to provide an acceptable level of safety without comparison to past practices.
- Conversely, it may help start us down the path of identifying where the mine safety practices may be lacking now and where they may be inadequate in the future.
- This would at least clearly allow for a path of semi-quantitative safety analysis.

SIL Levels According IEC 61508 / IEC 61511

SIL Safety Integrity Level	**PFDavg** Average probability of failure on demand per year (low demand mode)	**RRF** Risk Reduction Factor	**PFDavg** Average probability of failure on demand per hour (high demand or continuous mode)
SIL 4	**$\geq 10^{-5}$ and $< 10^{-4}$**	**100000 to 10000**	**$\geq 10^{-9}$ and $< 10^{-8}$**
SIL 3	**$\geq 10^{-4}$ and $< 10^{-3}$**	**10000 to 1000**	**$\geq 10^{-8}$ and $< 10^{-7}$**
SIL 2	**$\geq 10^{-3}$ and $< 10^{-2}$**	**1000 to 100**	**$\geq 10^{-7}$ and $< 10^{-6}$**
SIL 1	**$\geq 10^{-2}$ and $< 10^{-1}$**	**100 to 10**	**$\geq 10^{-6}$ and $< 10^{-5}$**

Prescriptive Requirements Barrier

This barrier results from the mining law being written so specifically that it mandates things that are irrelevant or obsolete relative to new technologies or prevent change.

Examples: Explosive transport boxes, red/blue outstations, methane measurements

NIOSH has recently made a contract award to review the regulations relative to potential barriers to automation for both surface and underground mines.

Regulatory change may be need to waive conflicting and needless prescriptive requirements to implement automation.

Fundamental Barrier to Risk Based Regulation

Risk based analysis and determining a SIL is mine specific:

- Mine operator is the only one that could do this realistically.

Mine operator would need to certify the SIL of the plan and accept responsibility legally (Paradigm Shift).

- Unlike OSHA regulated industries, currently the operator submits plans to MSHA and MSHA reviews the plan and verifies regulatory compliance.

There is no absolute “duty of care” clause for the operator, the operator must meet the regulations, not certify or guarantee safety.

    - May be one of the reasons the regs are so specific.

Wireless Systems regulatory (or lack thereof) Barrier

Wireless considerations may present implementation barriers due to lack of regulation and/or standards adoption. The potential areas are:

- Communications failure due to inadequate wireless coverage
- Unanticipated EMI between equipment and systems
- Poor system performance due to inappropriate or over-use of the unlicensed EM spectrum (Wireless coexistence)

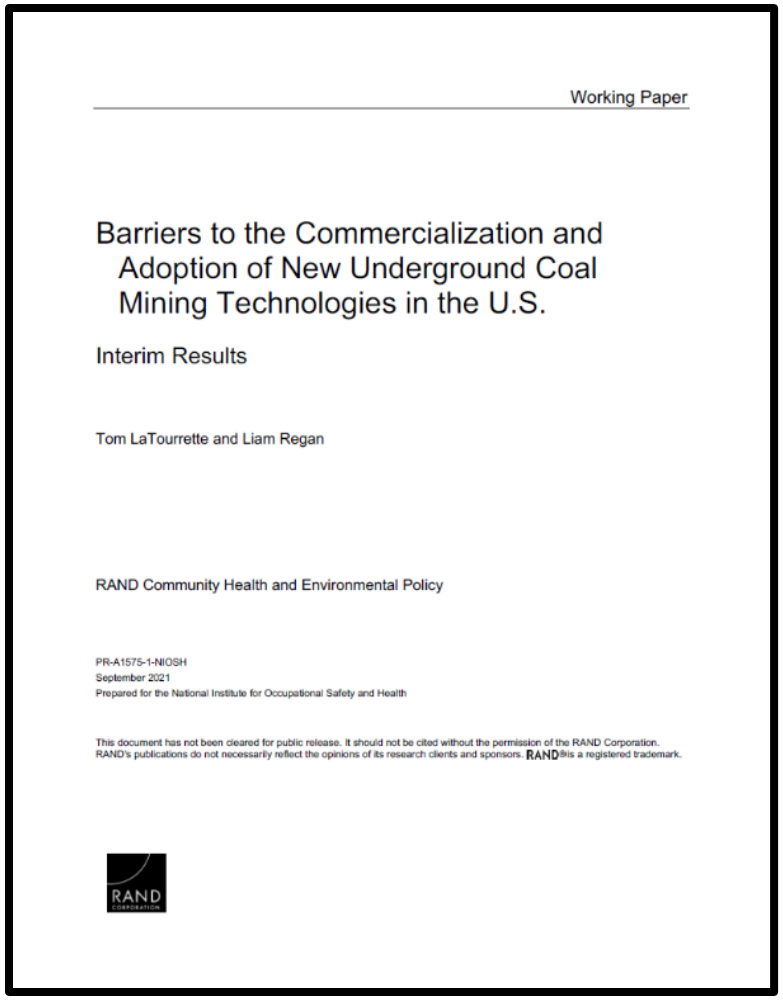
NIOSH has recently approved internal projects in the latter two areas.

Summary

The potential regulatory barriers may be daunting and need thorough consideration by mine operators when trying to introduce automation into U.S. mines.

Questions or Comments? David Snyder, fwx4@cdc.gov , 412/386-5304

RAND Study



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