ICMM Mining with Principles

EMESRT Earth Moving Equipment Safety Round Table

VEHICLE INTERACTION LEADING SITES PROGRAM

INTRODUCTION

Improving vehicle interaction controls in the mining industry is a complex challenge at the company and operating site level. There is an ongoing effort to improve operating approaches, including implementing technology solutions, particularly in reactive circumstances.

Each year, between 30-40% of industry fatalities are attributable to failures of vehicle interaction controls, and of these, about half involve pedestrians, mostly in underground operations.

The industry, including regulators, continues to see a high number of unwanted vehicle interaction incidents with a high potential for fatalities and serious injuries.

This, combined with the complexity and uncertainty of outcomes from existing technology, the rapid development of options, and interoperability concerns, meant an industry-user-driven response was needed.

BACKGROUND

Mining industry fatality experience tells us that no organisation has reliably sustained VI management. Since its formation, EMESRT has led and participated in industry-level initiatives with the common goal of improving the effectiveness and reliability of vehicle interaction controls in mining.

In 2016, EMESRT realised that vehicle interaction is a highly dynamic and complex topic due to the high level of human factor control aspects and that the potential solutions are quite diverse because of the different environments. EMESRT needed to expand its reach and the volume of aligned users to better influence designers. Understanding and implementing collision avoidance system technology projects is complex.

In 2017, EMESRT approached the International Council for Mining and Metals (ICMM) and in 2018, EMESRT and ICMM formed an industry partnership.

This partnership is part of the ICMM Innovation for Cleaner, Safer Vehicles (ICSV) broader initiative that aims to enhance safety practices in the mining industry by leveraging the expertise of members from both organisations. With a focus on promoting leading practices through capable solutions.

The ICSV initiative aims to:

- Introduce greenhouse gas-emission-free surface mining vehicles by 2040
- Minimise the operational impact of diesel exhaust by 2025
- Make collision avoidance technology available to mining companies by 2025

The initiative has CEO-level support that brings together company members, original equipment manufacturers, and technology suppliers in a non-competitive space to mobilise the investment needed to accelerate the development of a new generation of mining vehicles.

THE COMPELLING CASE FOR THE ICSV LEADING SITE STRATEGY

- Mining industry fatality experience - no organisation has got this right yet:
  - In 2018, the ICMM reported that 35% of industry fatalities from member companies occurred from operating mobile equipment or during transport
  - Of these about half are pedestrians
- Regulator expectations – globally and particularly in South Africa
- Understanding and implementing collision avoidance system technology projects is complex
- Identified industry level opportunities:
  - Share experience and knowhow to develop a common and structured understanding of the issues and opportunities
  - Confirm react and other technology innovation opportunities that can be operationally integrated to improve or replace what we do now
  - Use common problem definitions and functional performance scenarios to assist OEM and third-party Proximity Detection System (PDS) designers to develop industry level solutions
  - Identify and share design and operate innovation opportunities that can improve what we do now

LEADING SITES PROGRAM

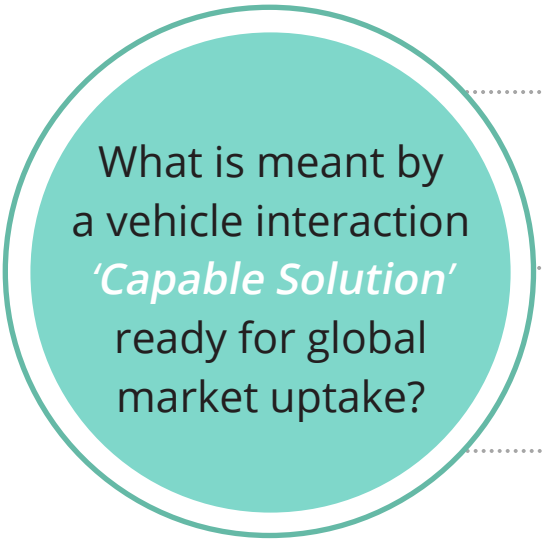
This Leading Sites program aims to improve the mining industry's VI performance. Notably, it seeks to improve safety through collaboration and the sharing of leading practices. It's a pivotal tool for driving continuous vehicle interaction control improvement in the mining industry.

One significant aspect of the ICMM Leading Sites program is its partnership connection with EMESRT.

The program provides a platform for transparent and meaningful two-way dialogue between mining companies, OEM's and technology providers. This dialogue helps identify and address equipment-related hazards.

A key platform of the Leading Sites program is the Capable Solution definition, which sets out three key principles of a VI improvement program.

LEADING SITES PROGRAM CAPABLE SOLUTION



A **capable solution** delivers better vehicle interaction control performance by improving the quality of decision-making from task execution through to mine operations and design.

A **capable solution** considers relevant aspects of the operating environment, production requirements and equipment design.

Where technology is a part of a **capable solution**, it is operationally integrated with existing controls.

PRINCIPLES AND SUCCESS FACTORS

1 There are no silver bullets.

Step 1 - Truly understand your problem

- How effective are our current controls?
- Even when performed as specified, do they really address common industry failure modes?

Step 2 – Use common industry failure modes to identify technology options that:

- Assist us to do better what we do now (Levels 1-7)
- Replace what we do now (Levels 8 and 9)

Key Reference: The EMESRT Vehicle Interaction Control Framework.

2 Adapt, apply and enhance, industry proven processes.

1. **Manage as a Project**
2. **Phase 1** – Understand your vehicle interaction control baseline i.e. know where are you starting from
3. **Phase 2** – Identify and correct any gaps between the baseline design and current operations
4. **Phase 3** – Enhance existing approaches, by selecting and implementing design and technology innovations that iteratively improve operations (doing what we do now – but better)
5. **Phase 4** – Identify and implement step change design and technology innovations that improve operations (replace, or add to, what we do now)
6. **Phase 5** – Fit your VI Control Improvement approach into the operating site and company digital strategy

Key Reference: The EMESRT Vehicle Interaction Control Improvement Guide.

3 Increase company, and industry knowhow and capability by sharing site experiences.

- **Understanding** that the most pressing mining industry fatality challenge is to systematically and reliably improve controls for managing mobile equipment operation and people and materials transport
- The **business case** for a consistent industry and company approach pivots on: cost, project complexity, the rapid development of technology options, the uncertainty of outcomes, and the wide range of in-company and industry information and experience that can be adapted and deployed
- Increasing company and industry **capability** to deliver complex projects
- Integrate **existing business processes** for change management, stakeholder engagement, capital allocation, supplier contracts, digital reporting and analysis, etc
- **Ongoing updating** and improvement of industry resources

4 Deeply understand the problem that you are trying to solve and know what use cases the technology will and will not solve.

Industry experience is that scoping, implementing, integrating and maintaining collision avoidance systems is complex because:

- During operations there is an ongoing dynamic interdependence between **design**, **operate** and **react** controls (reference EMESRT Level 1-9 Model)
- The successful implementation and integration of **react** controls requires a comprehensive baseline understanding of **design** and **operate** controls
- Success requires precisely understanding what technology does and does not do, taking a project approach, and human factors considerations in design

Industry Resources

- Develop and continually update scenario based functional performance requirements **(storyboards)**
- This resource provides structured information for use by OEM's, third-party technology providers and mining companies to **accelerate** equipment design and operational practice innovations
- Mining companies use these resources as the basis of **User Requirements** information prepared for potential technology providers

5 Consider the impact of the technology on human behaviour.

- Identifying that Human Performance can change both positively and negatively after technology is introduced
- Defining what problems that technology will solve for you
- Understanding what technology will not do for you
- Anticipating changes after technology is introduced
- Understanding what new hazards it may introduce

KEY CONCEPTS: THE EMESRT VEHICLE INTERACTION 9 LAYER MODEL

Reframing our understanding of Vehicle Interaction Controls.

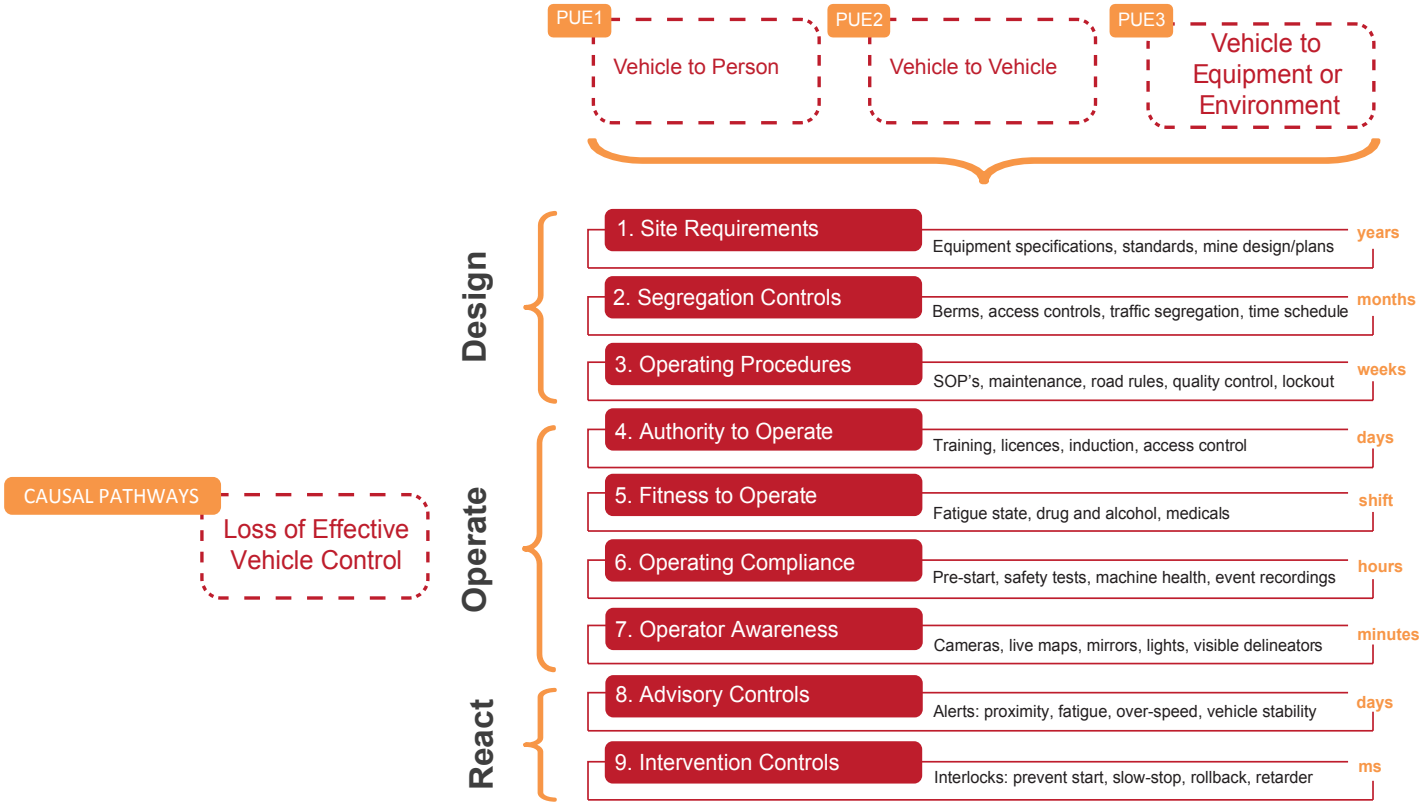
STRATEGY RELEVANCE

This Potential Unwanted Event (PUE) conceptual model is indicative only:

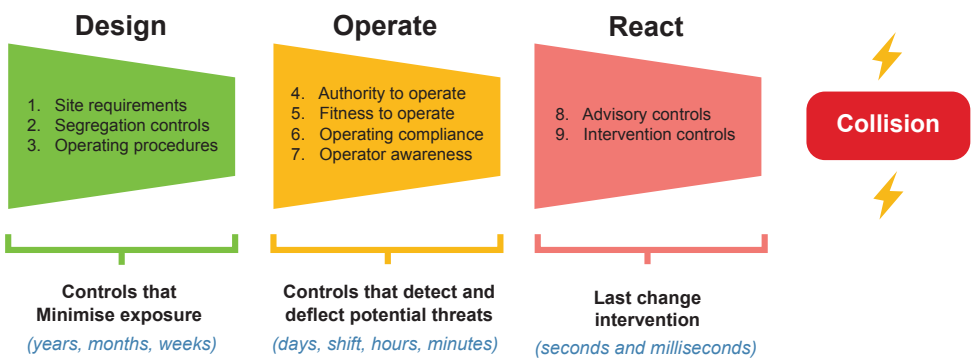
- It is a foundation concept
- It has dynamic interdependence between layers
- Layers operate in different time frames

For technical application of the model please refer to:

- Vehicle Interaction Control Improvement Project Guide
- Performance Requirement 5A - Vehicle Interaction Systems



KEY BASELINE AND VALIDATION: TIME PHASED PRIOR TO TA COLLISION



Vehicle Interaction Improvement Project Relevance

- Ongoing real world dynamic interdependence between control levels
- High dependence on human factor decision making in real time
- To implement Level 8 and 9 controls well, you first need to understand the effectiveness of your Level 1 - 7 baseline for normal operations