EMESRT

Earth Moving Equipment Safety Round Table

# Vehicle Interaction

## 9-Layers of Defence Guide

WORKING WITH INDUSTRY SINCE 2006.

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*EMESRT is a global 'safety by design' initiative established by mining companies to fill the functional performance expectations gap between earth moving equipment users and equipment designers.*

# DOCUMENT MANAGEMENT

## 1. VERSION HISTORY

Version 1 of the EMESRT Vehicle Interaction 9-Layers of Defence Guide was developed and published by EMESRT in 2025.

## 2. DISCLAIMER

While every attempt has been made to validate the contents of this EMESRT Vehicle Interaction 9-Layers of Defence Guide, the content has been collated from industry leading practice and therefore may change over time. For this reason, EMESRT reserves its right to update and re-issue the Guide as industry practice evolves.

## 3. CONDITIONS OF USE

EMESRT has an ambition to reduce the exposure to unwanted health and safety hazards from operating and maintaining mobile earth moving equipment. This is achieved by sharing leading practice information that can be referenced by users and designers when seeking to reduce the level of unwanted exposures to personnel. Connecting through a community collaboration of; end users, OEM's, researchers, and third-party suppliers it allows a deep understanding of the problems needed to be addressed to support industry level improvement.

### 3.1 TRANSLATIONS

This guide was developed and reviewed in English only. If the guide content, in part or in its entirety is translated, only the English version published by EMESRT is the approved version.

### 3.2 USAGE

- EMESRT makes the guide accessible to all of industry at no cost, it is not intended for sale or rent, in part or in its entirety, in any form including print, digital or other formats
- No financial gain is to be made by using this guide in part or in its entirety

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# INTRODUCTION

The intent of this EMESRT Vehicle Interaction 9-Layers of Defence Guide is to provide an introductory resource for improving vehicle interaction operational activities in the mining industry. This guide aims to help mine operators and stakeholders systematically address and mitigate potential unwanted interactions associated with mobile equipment operation. By outlining nine distinct layers of defense, the guide demonstrates that all aspects of vehicle interaction management are considered, from basic site requirements to advanced intervention systems.

The guide can provide a basis for collaboration between mining companies, equipment manufacturers, and technology providers to improve vehicle interaction performance, thus reducing the exposure to unwanted fatalities and incidents involving mobile equipment, which fosters a safer working environment for all personnel involved.

## NOTEWORTHY

### RELATED LIFE-SAVING BEHAVIOURS

1. Come to work drug and alcohol free
2. Use or wear fit for purpose safety equipment
3. Only operate equipment if trained and authorised
4. Seek approval before modifying or over-riding safety equipment
5. Seek and obtain clear approval before entering mobile equipment operating zones
6. Seek approval to enter danger zones
7. Report high potential hazard incidents

### ENABLING SYSTEM ACTIONS

1. Conduct a risk assessment of mobile equipment interactions for your site
2. Develop a Transport/Traffic Management Plan and apply associated procedures
3. Monitor the effectiveness of the operational requirements in reducing unwanted vehicle interaction

# BACKGROUND

According to the International Council on Mining and Metals member incident data, each year mining industry fatalities are attributable to unwanted vehicle interactions with a significant portion involving pedestrians in underground operations.

Since 2013, EMESRT has been working on the vehicle interaction improvement project. The EMESRT methodology is to focus deeply on defining the problem, getting a common understanding with a large group of stakeholders, then go to the designers and provide a common view of the problem with the intent that designers see it as a business opportunity in providing solutions for all or part of the problem.

## THE EMESRT VEHICLE INTERACTION IMPROVEMENT INDUSTRY PROJECT

The EMESRT Vehicle Interaction Improvement project aims to enhance the effectiveness and reliability of vehicle interaction operational requirements in the mining industry.

Key aspects of the project include:

- **Industry collaboration:** Bringing together mining equipment users, industry experts, equipment manufacturers, and other stakeholders to share knowledge and leading practices
- **Resource development:** In collaboration with industry, developing informative and useful industry resource materials
- **Technology integration:** Implementing and integrating new technologies to improve vehicle interaction management
- **Continuous improvement:** Focusing on ongoing improvements and updates to improve the effectiveness of vehicle interaction operational systems

With industry collaboration, this project has developed resource materials/tools specific to vehicle interaction that are available to industry via the **EMESRT website vehicle interaction improvement body of knowledge**, e.g.:

- Design Philosophy 5: Machine Operation and Control
- Performance Requirement 5A: Vehicle Interaction Systems
- The EMESRT 9-Layers of Defence model
- Surface and Underground Functional Performance Scenario Storyboards
- The EMESRT Operational Effectiveness approach
- Human Factors in Design Guide

## ACKNOWLEDGMENT

In consultation with industry stakeholders in 2024, the New South Wales (Australia) Resources Regulator sought to publish a vehicle interaction technical reference guide for open cut mines to reduce the number of unwanted vehicle interactions.

As part of the stakeholder consultation process, EMESRT provided subject matter expertise and reference materials.

During the development of the Resources Regulator's technical reference guide, the need for a greater definition of the vehicle interaction 9-layers of defence model emerged, as the existing EMESRT entry-level resources were more suited to mature mining sites.

The development of this guide is based on work done by an EMESRT member company in 2015. This work recognised the variable maturity entry levels across different sites, thus providing an entry point to support users with low levels of maturity in vehicle interaction operational effectiveness.

# EMESRT VEHICLE INTERACTION 9-LAYERS OF DEFENCE

The EMESRT Vehicle Interaction (VI) 9-Layers of defence approach is a foundation concept with dynamic interdependence between operational requirement layers (refer Figure 2). The layers operate in different time frames and have a high dependency on real-time human factors decision making.

EMESRT recognises that improving vehicle interaction operational activities is complex and interconnected. Leading practice is to establish the effectiveness of fundamental operational activities before being able to effectively implement higher-level activities (refer Figure 1). Successful introduction of new reactive operational activities (Layer 8 - 9) requires that each site review, and if necessary, improve existing vehicle interaction operational activities for design (Layer 1 - 3) and operate (Layer 4 - 7).

To implement Layer 8 and 9, you should first understand your Layers 1 to 7 effectiveness and improve them to meet the operational requirements.

The following pages contain operational activities that have been implemented by mine operators which have been effective in eliminating or minimising the potential for unwanted vehicle interactions.

Each operational activity has been grouped into the relevant EMESRT VI 9-layers of defence model, making it easier to understand how each activity contributes to reducing exposure to unwanted vehicle interactions.

**Figure 1:** The EMESRT Operational Effectiveness model.

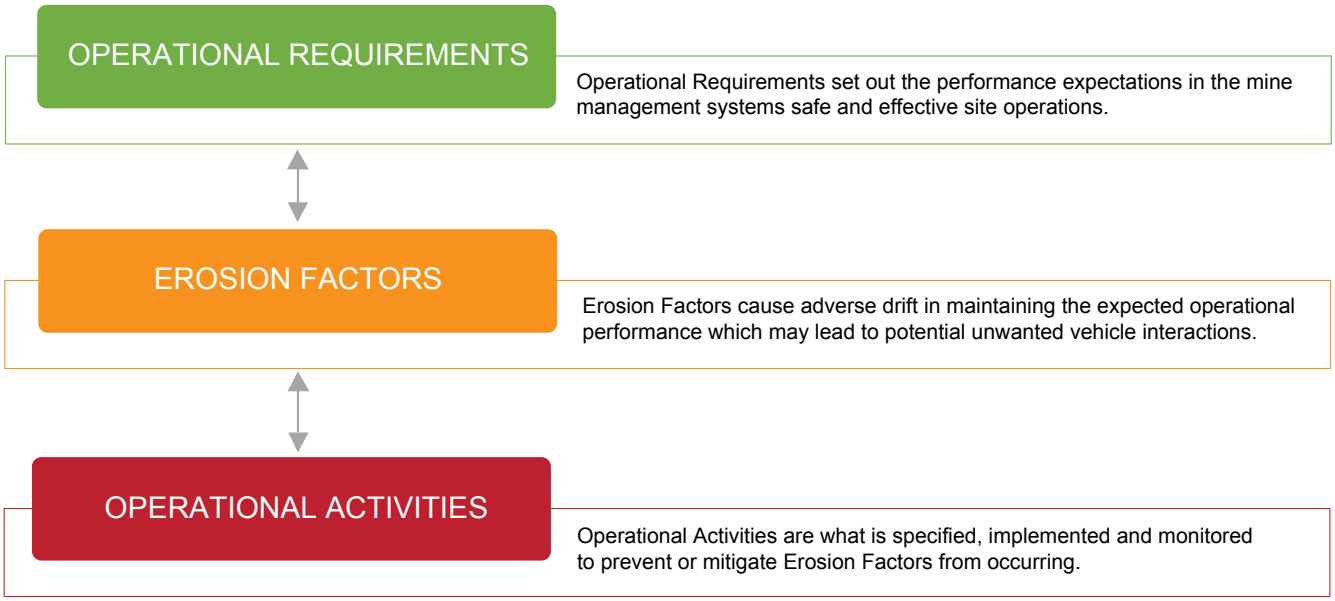
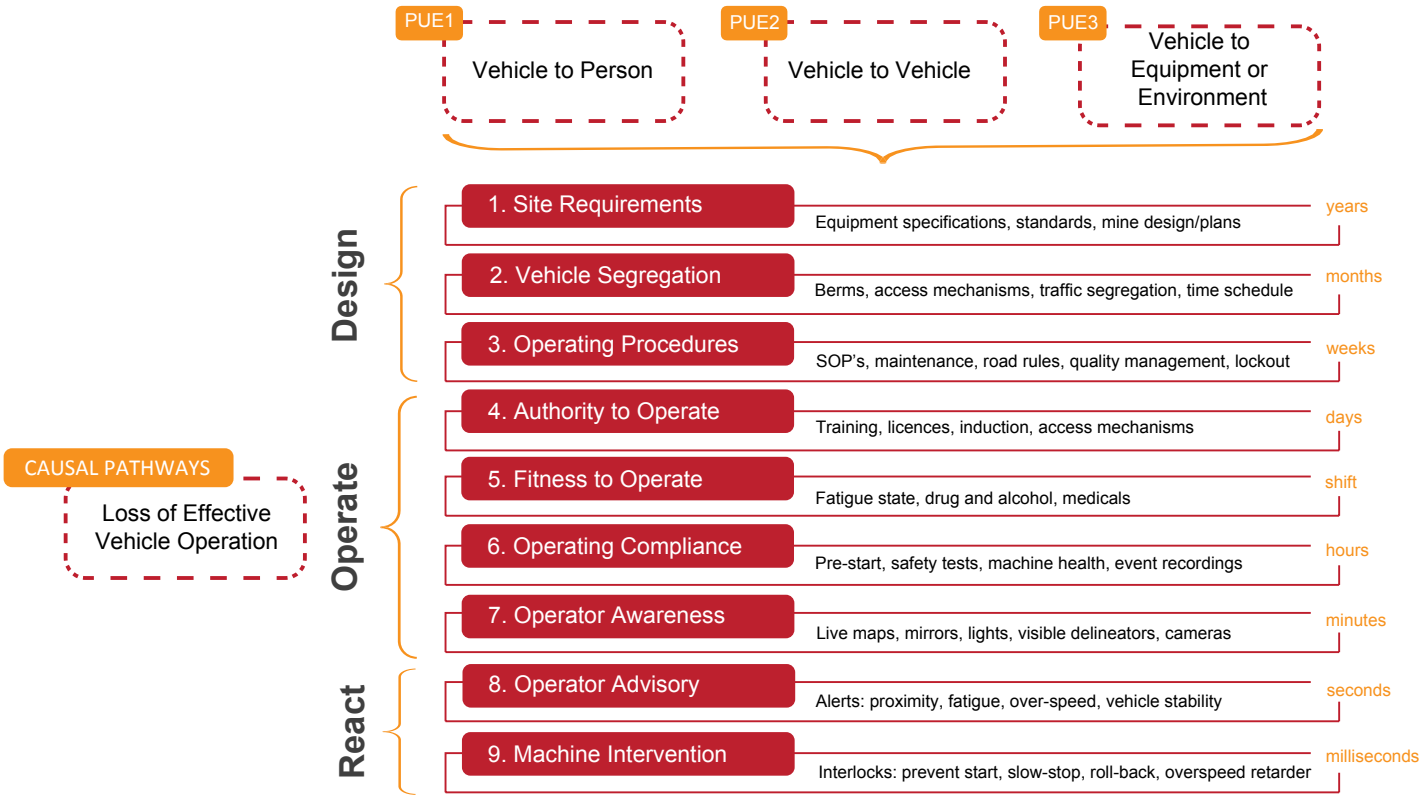



**Figure 2:** The EMESRT Vehicle Interaction 9-Layers of Defence model with examples of operational activities.



# LAYER 1: SITE REQUIREMENTS

Layer 1 of the EMESRT VI 9-layers of defence model focuses on site requirements, which include:

1. **Equipment specifications:** Equipment meets specific safety standards and is suitable for the intended tasks.
2. **Mine design:** Planning and designing the mine layout to minimise hazards, such as optimising traffic flow and maintaining adequate clearance between equipment and personnel.
3. **Standards:** Utilising industry guidelines, standards and regulations to minimise the potential for an unwanted vehicle interaction.

**OPERATIONAL ACTIVITIES**

Commonly applied operational activities include, but are not limited to:

- Mobile equipment with designed and approved seating, including seat belts or other restraints devices, can be used to transport personnel
- Identification and communication of mobile equipment sight lines and blind spots
- Provision of walkways and means of maintaining clearance from pedestrians and other vehicles
- Mobile equipment specifications are prepared by knowledgeable and experienced people who are familiar with production and operating environment demands
- Mobile equipment specifications apply when:
  - Purchasing new or used equipment
  - Transferring equipment to site
  - Hiring equipment
  - Assessing contractor equipment
- Mobile equipment specifications should include elements such as:
  - Operator access and egress
  - Maintainer access
  - Towing hooks/lugs designed to handle expected loads
  - Brakes
  - Steering
  - Tyres
  - Headlights and clearance lights
  - Indicators, warning lights, horns and alarms of sufficient volume to be heard in the operating environment
  - Vehicle identification numbers (unique, clear and visible) for surface operations
  - Mirrors and cameras (where fitted)
  - Communications equipment
  - Where implemented, operator proximity alerts, advisory and intervention technology
  - Fire suppression
  - Roll Over Protection Systems (ROPS)
  - Falling Object Protection System (FOPS) that exceed the maximum expected object force, e.g. when loading in pit or from under an ore or reject bin
  - Internal load barriers that protect operators and passengers
  - Mobile equipment reversing alarms
- Establish minimum dimensions and conditions for roadways and mobile equipment work areas in the Transport/Traffic Management Plan that specifies:
  - Maximum grade
  - Curvature and line of sight
  - Pavement shape and material
  - Guideposts spacing relative to the distance required between traveling vehicles
  - Guideposts reflector specification, e.g. red on driving side and white on offside
  - Signs and barriers
  - Lighting standards
  - Intersection designed as far as practical with a ninety-degree angle of approach

# LAYER 2: VEHICLE SEGREGATION

Layer 2 of the EMESRT VI 9-layers of defence model focuses on vehicle segregation activities. These activities are designed to physically separate vehicles from potential hazards and include:

1. **Berms:** Earth mounds or barriers that prevent vehicles from straying into dangerous areas.
2. **Access mechanisms:** Measures to restrict entry to hazardous zones, ensuring only authorised personnel can enter.
3. **Traffic segregation:** Designating specific routes for different types of traffic (e.g., pedestrian, vehicle).

**OPERATIONAL ACTIVITIES**

Commonly applied operational activities include, but are not limited to:

- Surface operations road width normally at least three times the width of the widest vehicle regularly using two-way haul roads
- The construction and maintenance of safety berms or windrows alongside roadways edges or areas where there is a sudden change in terrain, e.g. drop off, water body, or another hazard. The safety berms or windrows should be constructed using suitable (solid) materials, be of a height, density and profile to enable an effective barrier. The minimum height required is generally half the wheel height of largest vehicles using road

- The design and use of safety berms or windrows for delineation and segregation, e.g. at intersection approaches, corners so as not to impede visibility
- Physical barrier design and locations used to protect against access to unprotected benches or trenches
- The protection of fixed structures, including overhead power lines, buildings, refueling areas, elevated structures, bins, etc. during mobile equipment operations
- The approach to bridges and tunnels should clearly signpost the maximum height and width, and if relevant the maximum load capacity of vehicles that may transit
- As a minimum, the following should be established and included within the Transport/ Traffic Management Plan:
  - Traveling and clearance distance between equipment and people
  - Workplace design that, as far as practical, eliminates the interaction between pedestrians and mobile equipment, or assists in maintaining awareness using:
    - Segregated or dedicated walkways for pedestrians protected by windrows, bunds or other physical barriers
    - Delineation of no-go and danger zones for pedestrians
    - Pedestrian crossings in high pedestrian traffic areas
    - Horn signals to indicate vehicle operation prior to starting the vehicle, before forward movement, and before reversing (except in operating environments where this may create a hazard)
    - Establishing protocols for persons who work around operating mobile equipment to have a positive means of communicating with the equipment operator e.g. in a surface mining environment at least one member of the work party has an operating two-way radio
  - Workplace design and operational practice that manages mobile equipment interactions where practical using:
    - Separation of light and heavy vehicles using segregated roads
    - Use of remote bays, portable remote stands designed to withstand vehicle contact, and sensors that stop equipment when allowable proximity distances are breached for remote controlled mobile equipment
    - Park up areas with one-way traffic flow and segregated parking areas for heavy plant and equipment, light vehicles and pedestrians
    - Establishing park-up areas with spoon drains, humps (between front and rear axles) or some other method to prevent uncontrolled movement of vehicles
    - Establishing one-way traffic in high traffic areas, or installing centre berms or windrows
    - The installation of one-way block lights or other management systems for high traffic intersections

# LAYER 3: OPERATING PROCEDURES

Layer 3 of the EMESRT VI 9-layers of defence model focuses on operating procedures. This layer aims to establish effective operations through well-defined processes and operational activities. Key components include:

1. **Standard Operating Procedures (SOP's)**: Detailed instructions on how to perform tasks.
2. **Maintenance**: Regular and systematic upkeep of equipment.
3. **Road rules**: Specific guidelines for vehicle operation within the mine site.
4. **Lockout/tagout**: Isolation procedures to prevent machine operation.

These operating procedures are typically implemented over a period of weeks, allowing for thorough training and integration into daily operations.

**OPERATIONAL ACTIVITIES**

Commonly applied operational activities include, but are not limited to:

- A Transport/Traffic Management Plan or equivalent should be developed for surface and locations:
  - Operator pre-start equipment inspection and technology checks, based on original equipment manufacturer or approved engineering advice, and operating requirements
  - Method of fundamentally stable parking of mobile equipment e.g. park brake, chocks, spoon drains, humps (between front and rear axles)
  - The safe refueling of the mobile equipment
  - Stopping mobile equipment when boarding or dismounting
  - Mobile equipment limitations including the maximum loads that may be carried or towed
  - Speed limits by equipment type, location and conditions
  - Managing changes in road surfaces
  - Operating around fixed structures, such as conveyor and bin trestles, building supports, power poles, etc
  - Minimum personal protective equipment (PPE) requirements including high visibility clothing
  - Give way requirements for mobile equipment operators and pedestrians
  - Managing road repair works, including grader operations
  - Radio (or other communications) call up protocols are used
  - Procedures for approaching mobile equipment
  - Procedures for towing
  - Parking in operational areas including the means of isolating of equipment and activity from danger of collision during breakdowns, emergencies, infield servicing, refueling and maintenance
    - Education and awareness for workers
    - Shift roster design
    - Defined hours of work and rest requirements, including travel time and a process to manage additional hours of work
    - Advice and support for supervisors including fatigue call-ups during shift and how to manage fatigued persons from the workplace
  - A baseline assessment of existing mobile equipment fatigue management
- Mobile equipment related potential emergency scenarios should be identified, and emergency response procedures are to include equipment and response requirements e.g. fire response, trauma first aid, extrication of trapped or pinned personnel; power line contact and potential tyre explosion, etc

- Operator pre-use inspections including highlighted specific machine down items
- Method of notifying and managing equipment failures during operations
- Scheduled inspection, servicing and maintenance programs for mobile plant and support equipment, e.g. radio communication system including networks; and key systems e.g. proximity detection systems, brakes, tyres and lubrication
- Road maintenance practices that will maintain a proper road surface (e.g. snow removal, sanding, managed roadway watering for dust management, etc.)
- Vehicle parking requirements that include parking distances from other equipment and structures
- Dust management
- Operational requirements should consider the separation of buses from heavy vehicles or the requirement to stop operation of heavy vehicles when buses pass

# LAYER 4: AUTHORITY TO OPERATE

Layer 4 of the EMESRT VI 9-layers of defence model focuses on authority to operate. This layer establishes that only qualified and authorized personnel operate vehicles and perform tasks. Key components include:

1. **Training:** Comprehensive training programs to enable all personnel to be knowledgeable about operational procedures and protocols.
2. **Licences:** Issuing and maintaining valid licences for operators to confirm their qualifications and competency.
3. **Induction:** Conducting thorough induction programs for new employees to familiarize them with site-specific operational requirements and procedures.
4. **Access mechanisms:** Implementing systems to manage and monitor access to mine vehicle operating areas, validating only authorised personnel can enter

**OPERATIONAL ACTIVITIES**

Commonly applied operational activities include, but are not limited to:

- Personnel who operate or work around vehicles should be trained, competent and authorised. A training plan should be developed and include:
  - Criteria for selecting and appointing vehicle operators. This should include a physical assessment of capability to reach and operate all controls
  - Training needs based on work role, site rules and procedures, licensing requirements, Original Equipment Manufacturer (OEM) guidance and other recognised standards
  - Competency assessment criteria, with records retained
  - A periodic review and update of competency requirements, training needs, training content and methods

# LAYER 5: FITNESS TO OPERATE

Layer 5 of the EMESRT VI 9-layers of defence model focuses on fitness to operate. This layer establishes that personnel are physically and mentally fit to perform their duties safely. Key components include:

1. **Fatigue state:** Monitoring and managing fatigue levels to prevent accidents caused by tiredness. This can include scheduling adequate rest periods and using fatigue detection systems.
2. **Drug and alcohol testing:** Implementing regular testing to establish that employees are not under the influence of substances that could impair their ability to operate effectively.
3. **Medicals:** Conducting regular medical examinations to establish that employees are in good health and capable to operate effectively.

**OPERATIONAL ACTIVITIES**

Commonly applied operational activities include, but are not limited to:

- An effective fatigue management system should be applied
- Consideration for the introduction of technology to support existing fatigue management activities

# LAYER 6: OPERATING COMPLIANCE

Layer 6 of the EMESRT VI 9-layers of defence model focuses on operating compliance. This layer establishes that operators are compliant with established operational procedures and protocols. Key components include:

1. **Pre-start checks:** Routine inspections conducted before operating machinery to establish it is in effective working condition.
2. **Safety tests:** Regular testing of safety systems and vehicle functions. Self testing systems are preferable with advice to the operator of abnormal function.
3. **Machine health monitoring:** Continuous monitoring of machinery to detect and address any issues that could compromise operational requirements.
4. **Event recordings:** Documenting and analyzing incidents and near-misses to identify trends and implement corrective actions.

**OPERATIONAL ACTIVITIES**

Commonly applied operational activities include, but are not limited to:

- Mobile equipment being used within approved design parameters
- Access to operational areas including positive communication methods
- Handheld mobile phones should not to be used when operating mobile equipment
- Assessment of the potential benefits of technology to support or replace existing fatigue management mechanisms for mobile equipment operators
- Establishing functional and performance requirements of the technology to achieve operational requirements
- Applying positive communication where the caller and receiver identify vehicle and clearly respond
- Include the use of in-vehicle monitoring systems to monitor driver behaviour
- Effective operator responses to mobile equipment faults, alerts and alarms
- Seat belts and /or restraints should be worn where fitted

# LAYER 7: OPERATOR AWARENESS

Layer 7 of the EMESRT VI 9-layers of defence model focuses on operator situational awareness. This layer aims to introduce technologies that provide information to enhance the ability to comprehend the immediate environment and understand potential hazards in the vicinity through providing:

- Enhanced situational awareness
- An alert on potential abnormal scenarios
- Contextual information of the threat in an abnormal scenario such as
  - Where is it?
  - What is it?
  - How far away is it?
  - What is its heading?
  - How fast is it going?
- Visual confirmation of a potential abnormal situation

Key components include:

1. **Live maps:** Offering dynamic, up-to-date maps that show the location of vehicles and / or personnel.
2. **Mirrors:** Enhancing visibility around the vehicle to reduce blind spots.
3. **Lights:** Improving visibility in low-light conditions to enable operators to comprehend the environment around them.
4. **Visible delineators:** Marking boundaries and hazards clearly to guide operators on established roadways.
5. **Cameras:** Providing real-time visual information to help operators monitor their surroundings to reduce blind spots.

**OPERATIONAL ACTIVITIES**

A review and planning exercise should be conducted to introduce situational awareness technology for priority vehicles.

# LAYER 8: OPERATOR ADVISORY

Layer 8 of the EMESRT VI 9-layers of defence model focuses on advisory activities. This layer aims to provide operators with timely alerts to enhance their situational awareness and identify imminent threats.

**TECHNOLOGY EFFECTIVENESS**

- Technologies that provide alarms and specific instructions enhance the ability to predict potential unwanted interactions
- These technologies determine imminent threats of collisions, provide specific instruction signals to vehicle operators to react, and prompt operators to consider other contributing situational factors before reacting to prevent collisions or mitigate the potential consequences. They also outline expected operator responses to mobile equipment faults, alerts, and alarms, and include the use of in-vehicle monitoring systems to monitor driver performance

Key components include:

1. **Proximity alerts:** Notifications when the vehicle is close to other objects or personnel.
2. **Fatigue alerts:** Systems that monitor the operator's alertness and provide physical and audible alerts to the operator if signs of fatigue are detected.
3. **Over-speed alerts:** Warnings when the vehicle exceeds predetermined speed limits, prompt operators to reduce speed to the required level.
4. **Vehicle stability alerts:** Notifications about potential stability issues, such as tipping on uneven ground to prompt corrective actions

**OPERATIONAL ACTIVITIES**

Commonly applied operational activities include, but are not limited to:

- Operations should conduct risk assessments to identify situations where operators or pedestrians should be alerted to hazards or a vehicle's health or operating status. This assessment helps determine when and where operator advisory mechanisms should be installed
- Consideration should be given to human factors design in alarming methods and operator recognition so that specified information and warnings are acted upon effectively
- Examples of operator advisory signals related to vehicles include radar-operated speed alerting screens, in-vehicle alarms for over-speeding, fire, proximity of other vehicles or pedestrians, and operator seat vibrators designed to alert fatigued drivers

# LAYER 9: MACHINE INTERVENTION

Layer 9 of the EMESRT VI 9-layers of defence model focuses on machine intervention. This layer aims to automatically intervene when there is an imminent threat of a collision.

Key components include:

1. **Interlocks:** Safety mechanisms that prevent vehicles from operating outside the operational requirements. Examples include but are not limited to the following:
   - **Prevent start**: Systems that prevent machinery from starting if certain operational requirements are not met.
   - **Slow-stop:** Gradual stopping mechanisms to safely reduce vehicle speed with operational requirements.
   - **Roll-back prevention:** Systems that prevent vehicles from rolling back unintentionally, especially on slopes.
   - **Overspeed retarder:** Devices that regulate vehicle speed, particularly on downhill slopes, to prevent runaway incidents
2. **Collision avoidance system:** Systems that provide a specific instruction signal to the vehicle to slow/stop
   - The vehicle then assesses the slow/stop instruction in relation to other contributing factors before reacting to prevent a collision or mitigate significant consequences
   - The system should relinquish intervention to the operator if they take evasive action
   - The system should provide a manual override to recover after a collision intervention scenario has occurred

# IN CONCLUSION

The EMESRT Vehicle Interaction 9-Layers of Defence Guide represents the first step in the comprehensive approach to reducing unwanted vehicle interactions in the mining industry by systematically addressing vehicle interaction operational requirements.

By providing a structured framework that spans from site requirements to advanced intervention mechanisms, the guide systematically addresses the causes of unwanted interactions associated with mobile equipment.

The collaboration between mining companies, OEM's, technology providers and other stakeholders under the EMESRT initiative has led to advancements in operational systems and equipment design.

As the industry continues to evolve, the EMESRT VI 9-layers of defence guide will remain a useful tool in eliminating or mitigating unwanted vehicle interactions, ultimately fostering a safer working environment for all personnel involved.

The EMESRT VI 9-layers of defence model is a comprehensive structure designed to enhance safety in mining operations by implementing multiple layers of defence.

A brief summary of each layer:

1. **Site requirements:** Establishing machinery specifications, mine design, and alignment with published standards.
2. **Vehicle segregation:** Implementing physical barriers like berms, access systems, and traffic segregation.
3. **Operating procedures:** Establishing SOP's, maintenance routines, road rules, compliance validation, and lockout/tagout procedures.
4. **Authority to operate:** Providing training, licences, induction programs, and operational area access systems.
5. **Fitness to operate:** Monitoring fatigue, conducting drug and alcohol tests, and regular medical examinations.
6. **Operating compliance:** Performing pre-start checks, interlock tests, machine health monitoring, and operational activity event recordings.
7. **Operator awareness:** Enhancing situational awareness with cameras, live maps, mirrors, lights, and visible delineators.
8. **Operator advisory:** Providing alerts to vehicle operators for proximity, fatigue, over-speed, and vehicle stability.
9. **Machine intervention:** Implementing interlocks, prevent start systems, slow-stop mechanisms, roll-back prevention, and overspeed retarders.

By systematically integrating these layers, the layered defence model aims to create a robust set of operational activities that minimise unwanted vehicle interactions and enhances the overall safety of mining operations.

Each layer builds upon the previous one, providing a comprehensive and systematic approach to address and mitigate potential unwanted vehicle interactions associated with mobile equipment in the mining industry.

# GLOSSARY OF TERMS

| Term | Description |
|---|---|
| Erosion Factors | Erosion factors are the multiple ways that the operational requirements can be compromised. |
| Design Philosophy 5: Machine Operation and Control (DP-5) | The objective of DP-5 is to prevent harm, during machine operation and control, to as low as reasonably practical, including consideration in design for foreseeable human error. |
| Earth Moving Equipment Safety Round Table (EMESRT) | EMESRT is a global 'safety by design' initiative established by mining companies to fill the functional performance expectations gap between earth moving equipment users and equipment designers. |
| EMESRT 9-Layers of Defence Model | The approach is a foundation concept with dynamic interdependence between operational requirement layers. The layers assess the actions required to achieve the different layers of protection. |
| EMESRT 9-Layers of Defence Guide | The intent of the Guide is to provide an introductory resource for improving vehicle interaction operational activities. It aims to help mine operators and stakeholders systematically address and mitigate potential unwanted interactions associated with mobile equipment operation.<br><br>By outlining nine distinct layers of defence, the guide demonstrates that all aspects of vehicle interaction management are considered, from basic site requirements to advanced intervention systems. |
| Falling Object Protection Systems (FOPS) | FOPS are safety devices fitted to heavy machinery, like tractors and earthmoving equipment, to protect operators from falling objects like rocks, tree limbs, or debris. |
| Functional Performance Scenario Storyboards | The surface and underground functional performance scenario storyboards provide a visual and dynamic reference for equipment operators, technology suppliers, vehicle interaction improvement project managers as they implement the EMESRT 9-Layers of Defence model. |
| Human Factors in Design Guide | A human-centered design process to support developers and sponsors of new technology related to vehicle interactions. |

| Term | Description |
|---|---|
| NSW | New South Wales, a state in Australia. |
| Original Equipment Manufacturer (OEM) | An OEM is a company that produces parts or equipment that are marketed and sold by another company, often under a different brand name. |
| Operational Activities | Operational activities undertaken by mine personnel to prevent or mitigate the erosion factors from compromising the operational requirements. |
| Operational Requirements | Operational requirements establish the operating parameters that should be maintained for safe and productive operations. |
| Performance Requirement 5A: Vehicle Interaction Systems (PR-5A) | PR-5A is a key enabler in the collision awareness technology integration process for Vehicle Interaction improvement. It provides an understanding of the role technology plays at levels 7, 8 and 9 through a management model that depicts the 9 defensive layers which provide differing levels of process controls to prevent an unwanted vehicle interaction.<br><br>It has been developed to augment interpretation of Design Philosophy 5, and should be read in conjunction with the design philosophy. |
| Roll Over Protection System (ROPS) | ROPS are designed to reduce the possibility of a seat belted operator being crushed should the machine roll over. |
| Standard Operating Procedures (SOP) | A SOP is a written document that outlines the step-by-step instructions for performing specific tasks or operations. |
| Transport/Traffic Management Plan | A traffic management plan describes how the mine operator will manage the flow of traffic at the mining operation. This includes road and other related design parameters and road rules. |
| Vehicle Interaction (VI) | VI encompasses the interactions between vehicles and other elements within an operating areas, such as other vehicles, pedestrians, structures, equipment or the natural environment. |

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