EMESRT

Earth Moving Equipment Safety Round Table

EMESRT.ORG

ACTIVITY REPORT

2023

WORKING WITH INDUSTRY SINCE 2006

GLOSSARY OF TERMS

ACARP	The Australian Coal Industry's Research Program
BI	Business Inputs
CFM	Credible Failure Modes
CFw	Control Framework
DP	Design Philosophy
EAG	EMESRT Advisory Group
EMESRT	Earth Moving Equipment Safety Round Table
FDSS	Fire Detection and Suppression System
ICMM	International Council on Mining and Metals
ICSV	Innovation for Cleaner Safer Vehicles
ISO	International Standards Organisation
OEM	Original Equipment Manufacturer
OTR	Off the Road
PDS	Proximity Detection System
PR	Performance Requirement
ROS	Required Operating States
TWG	Technical Working Group
VI	Vehicle Interaction

INTRODUCTION

Welcome to the EMESRT 2023 Activity Report.

The Earth Moving Equipment Safety Round Table (EMESRT) is a global industry initiative involving major mining companies. EMESRT focuses on advancing the design of equipment to improve safe operability and maintainability beyond standards.

Formed in 2006, EMESRT, a membership-based entity, remains the 'common voice' of the mining industry and brings together key stakeholders to collaborate and share leading practices in order to reduce the hazards associated with earth moving equipment.

Through genuine two-way engagement with all stakeholders, EMESRT delivers an industry-level understanding of complex health and safety problems. This collaborative effort ensures that a wide range of perspectives are considered when developing equipment design improvements and industry resources.

The success of EMESRT is based on trusted relationships, open and honest dialogue, and a practical industry-level approach that:

- Defines the landscape of the problem
- Identifies stakeholders who can influence design changes
- Stimulate stakeholders to work on industry-level improvements through collaboration

This 2023 Activity Report provides a summary of EMESRT activities, including progress on industry-level focus areas, engagement with industry, and how EMESRT operates.

The EMESRT Advisory Group hopes readers find the content useful and relevant.

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EMESRT

EMESRT is a global 'safety by design' initiative established in 2006 by mining companies to fill the functional performance expectations gap between earth moving equipment users and equipment designers.

VISION

A mining industry free of fatalities, injuries and occupational illnesses associated with operating and maintaining earth moving equipment.

PURPOSE

Accelerate development and adoption of leading practice designs to minimise the risk to health and safety through a process of Original Equipment Manufacturer, contractor and user engagement.

OPERATING PRINCIPLES

- Design beyond standards
- Balancing engineering and behaviour (human factors)
- Recognising the value of task-based design review
- Appreciate that the OEM does its best with the end user involved
- Open genuine two-way engagement contractor and user engagement

ACKNOWLEDGEMENT

The EMESRT Advisory Group acknowledges and greatly appreciates the individual contributions of member company representatives and others from the broader EMESRT community of: Mine Operators, Original Equipment Manufacturers (OEM), third party equipment suppliers, Researchers, Industry Groups and others.

Since 2006, their contributions at meetings, workshops, webinars and other activities have directly supported the delivery of the EMESRT vision and they are part of the EMESRT success story.

MEMBERS FOR 2023

TIER 1

1. Alcoa
2. Anglo American
3. AngloGold Ashanti
4. BHP
5. Glencore
6. Kiewit
7. New Hope Group
8. Rio Tinto
9. Teck Resources
10. Vale
11. Whitehaven Coal

TIER 2

1. Tronox

ADVISORY GROUP

The EMESRT Advisory Group (EAG) plays a crucial role in guiding EMESRT initiatives and ensuring the continuous improvement of leading practices in the mining industry.

The EAG comprises one representative from each Tier One member company and provides strategic direction for all technical working group activities to ensure consistency in messaging to Original Equipment Manufacturers (OEM's) and third-party manufacturers and suppliers.

The EAG provides valuable insights and experiences that enhance the effectiveness of EMESRT's program of activities.

OBJECTIVES OF THE EAG

The EAG has several primary objectives. These include:

- Development and implementation of EMESRT's strategic work plans and initiatives:
  - Identifying, rigorously defining, and documenting the problem landscape to be addressed from the perspective of mining equipment users and agreeing on appropriate actions to stimulate industry activity to address the problem
  - Promoting collaboration among key industry stakeholders to address equipment safety challenges
  - Preparing a draft industry improvement project scope and project plans
- Building project communities through subject-focused technical working groups
- Sharing knowledge and experiences to facilitate continuous improvements through stakeholder education on the problems

Each member contributes to the group based on their diverse experience, skills and availability and may lead one or more agreed priority work areas.

KEY RESPONSIBILITIES OF THE EAG

The EAG contributes to EMESRT's vision and purpose by fulfilling a range of responsibilities. These include:

1. Participating in monthly meetings to discuss membership, activity funding, current industry focus area project progress, stakeholder engagement opportunities, and industry emerging issues
2. Participating in the strategic planning annual workshop
3. Providing input on the development of industry resource materials
4. Collaborating with other industry organisations to promote leading practices in equipment design
5. Offering guidance on the communication strategies employed by EMESRT to raise awareness

BENEFITS OF BEING AN EAG MEMBER

Being a part of the advisory group offers numerous benefits to EMESRT members. These include:

- Access to a network of industry experts and professionals which provide
  - Opportunities for collaboration and knowledge sharing
  - Exposure to the latest safety innovations and technologies
  - Exposure to global safety trends and leading practices
- Early involvement in developing industry resource materials
- Ability to influence earth-moving equipment design improvements by direct collaboration with OEM's
- Influence in the development of industry standards through EMESRT Liaison status with International Standards Organisation (ISO) committees

STRATEGIC PLANNING

In early December 2023, the advisory group members attended the annual three-day strategic review workshop in Brisbane, Australia.

The purpose of the workshop was to confirm the current focus areas and overall strategic direction of EMESRT for 2024 and future years.

Industry focus area project selection is based on member and industry experience and concern, a compelling case for improvement, and EMESRT's ability to influence change.

EAG members have the opportunity to lead and contribute to one or more focus area projects.

In attendance were several new EMESRT member representatives and several new representatives for existing member companies. The project leads presented the original EMESRT principles and current projects intent.

This provided a good base understanding of the underlying EMESRT operating principles for the group and engendered greater involvement in setting action plans and enabling people from member companies to get involved in the review of the work plan activities.

Current focus areas:

1. Vehicle interaction control improvement
2. Tyre and rim management
3. Mobile equipment fire management

The history and current status of the three existing focus area projects were presented to the advisory group and were well received and supported.

In early 2024, detailed activity planning will be undertaken in relation to the current focus area projects and action items that need to be completed for each project. Project plans will be updated with the scope, actions, and resources required.

More information on the above focus area projects is available in the following section of this report.

MEMBERSHIP AND MEMBER RELATIONSHIPS

In 2023, existing EMESRT members welcomed New Hope Group and Whitehaven Coal as Tier 1 members. Whitehaven Coal joined as a Tier 2 member in 2022 and made a conscious decision to move to a Tier 1 membership, enabling them to have greater influence in helping shape the overall EMESRT strategic focus.

The new Tier 1 members join existing member companies: Alcoa, Anglo American, AngloGold Ashanti, BHP, Glencore, Kiewit, Rio Tinto, Teck Resources, and Vale.

EMESRT member companies bring a wealth of knowledge and experience to the table and collaborate closely with OEM's and equipment designers to influence improved health and safety outcomes.

Advisory group members actively promote the EMESRT engagement process at industry forums to a wide international audience and have introduced resource materials developed by EMESRT to help understand the hazards faced by operators and maintainers of earth-moving equipment.

EMESRT SUCCESS FACTORS

In early December 2023, the advisory group discussed its relevance and performance over the past 17 years. Strong acknowledgement of the improvement work EMESRT has achieved to date was voiced by all members.

This acknowledgement is supported by the global interest in EMESRT's work, membership growth, and an extensive increase in technical working group patronage.

Maintaining a focus on realistic outcomes is a key driver for EMESRT.

The EMESRT 2023 review confirmed these five success factors:

1. Working with an industry-level focus
2. Having a real-world business understanding of financial drivers and leverage
3. Understanding that innovation is market-driven, not pushed by technology
4. A good governance process to cover structure, funding, risk management, renewal, and continuity
5. Senior management (decision-maker) endorsement

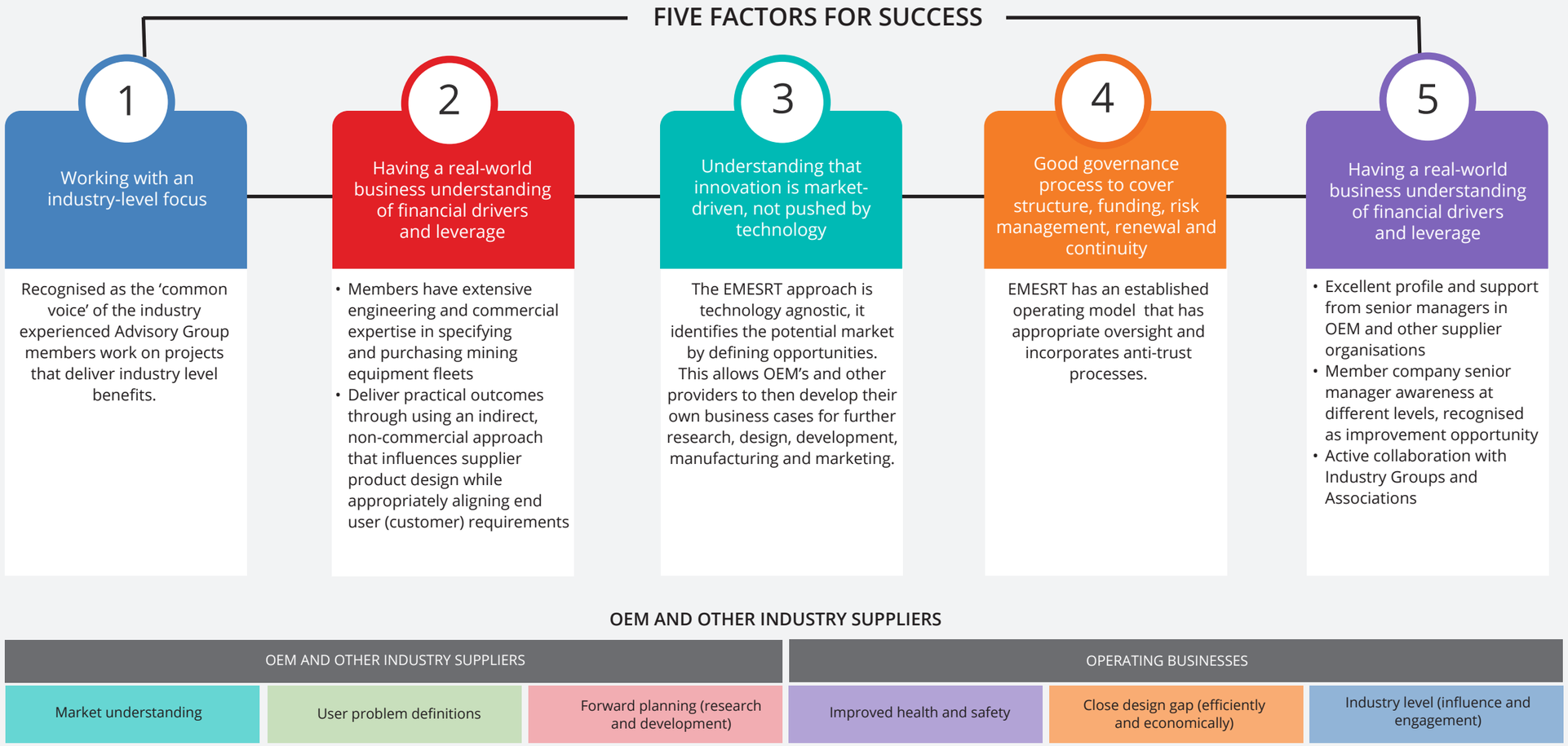


Figure 1: The EMESRT five factors for success.

TECHNICAL WORKING GROUPS

To achieve its vision and purpose, EMESRT has established various working groups that collaborate on specific focus area topics. These working groups bring together industry experts, equipment manufacturers, mining companies, technology providers, end users, researchers, and others to share knowledge and experiences.

The EMESRT working groups aim to discuss and address significant health and safety issues in the mining industry by leveraging the collective expertise of industry stakeholders.

During 2023, these groups focused on specific areas such as vehicle interaction, tyre and rim management, and mobile equipment fire management. By pooling resources and knowledge, the EAG and working group members work towards developing practical improvement resource materials that can be implemented across the industry.

In 2023, EMESRT experienced a significant growth in working group member numbers. This increase in interest leads to more expertise getting aligned and contributing to the work done by the working groups.

In summary, EMESRT continues to maintain its relevance to industry through an extended global reach, with new members joining and additional technical working group patronage.

The EMESRT Advisory Group extends its appreciation to all involved for their time, contribution, commitment, and continued support in delivering EMESRT's vision and purpose and looks forward to continuing the collaborative approach in 2024.

INDUSTRY ENGAGEMENT

In today's fast-paced and ever-evolving mining landscape, industry engagement plays a pivotal role in fostering collaboration and influencing improvements in the design of earth-moving equipment.

The EMESRT collaborative approach has fostered a culture of knowledge and experience sharing and cooperation with the mining industry. By bringing together diverse stakeholders, EMESRT has facilitated the exchange of ideas and leading practices, resulting in continuous improvement. It facilitates regular monthly meetings, workshops, and webinars where participants openly discuss safety concerns and share their knowledge and experiences.

EMESRT brings together mining companies, original equipment manufacturers, regulators, third-party providers, researchers, and users to collectively address safety challenges associated with earth-moving equipment. Through active participation and collaboration, the EMESRT community can collectively define problems and seize opportunities for design improvements.

Throughout the year, EMESRT continued to collaborate with the ICMM Innovation for Cleaner, Safer Vehicles (ICSV) initiative and hosted two Vehicle Interaction (VI) leading sites workshops in Brisbane, Australia. Both were followed by the underground functional performance scenario storyboard development workshops. The workshops garnered great attendance and active participation.

During 2023, EMESRT also presented on all three current areas of focus at several industry-coordinated engineering forums and to the Australasian Institute of Mining and Metallurgy, both in Australia and New Zealand.

DESIGN PHILOSOPHIES

EMESRT published a unified set of Design Philosophies (DP's) for earth moving equipment used in mining operations. The DP's provide an overall understanding of the material problems that create unwanted exposure that users encounter, with an emphasis on human-centered design deficiency aspects.

In 2023, the EMESRT Advisory Group reviewed all eight design philosophies with respect to human factors design diversity and the introduction of alternative energy/powered earth moving equipment. The group will finalise and publish the updated design philosophies in 2024.

EMESRT EIGHT DESIGN PHILOSOPHIES

DP 1: Access and working at heights

The objective is to prevent harm related to access and working at heights (where there is a risk of falling at least 6' (1.8m) or if serious injury may result) on equipment; to prevent slip/trips, sprains/strains, falls from height and failure to egress in emergency events to as low as reasonably practical, including consideration in design for foreseeable human error. For example, injury during access to equipment and its routine service and inspection points, work platforms and operator workstations due to poor location of service and inspection points, lack of fall-from-height protection, premature failure of components due to corrosion, slippery surfaces, accumulation of dirt or other material, or poorly lit environments.

DP 2: Tyres and rims

The objective is to prevent harm related to tyre and rim events to as low as reasonably practical, including consideration in design for foreseeable human error and material failures. For example, harm due to uncontrolled release of pressure from the tyre and rim assembly during operation and maintenance.

DP 3: Exposure to harmful energies

The objective is to prevent harm related to exposure to moving machine parts, failure of hydraulic equipment or systems, or other energy sources, such as compressed air, heat, electricity and gravity to as low as reasonably practical, including consideration in design for foreseeable human error. For example, harm from exposure to energies such as heat, electricity, radiation, compressed air, high pressure fluids (including hydraulic fluids) and falling objects.

Aligning unwanted events into eight material problem categories.

DP 4: Fire

The objective is to prevent harm related to equipment fires to as low as reasonably practical, including consideration in design for foreseeable human error. For example, harm from fire arising from damage (including heating, melting and chaffing) to electrical cables and components, hydraulic hoses and fuel lines due to design inadequacies including poor location, inadequate separation of fuel and ignition sources, and flaws in clamping or restraints.

DP 5: Machine operation and control

The objective is to prevent harm, during machine operation and control, to as low as reasonably practical, including consideration in design for foreseeable human error. For example, musculoskeletal injury or illness due to workstation design (including seat and seatbelt design, openings and cab height) that promotes biomechanically compromised postures for the 5th percentile female to 95th percentile male body dimensions.

DP 6: Health impacting factors

The objective is to prevent harm from exposure to health impacting factors to as low as reasonably practical, including consideration in design for foreseeable human error. For example, harm from exposure to health hazards such as extreme temperatures, excessive vibration and noise levels, particulates, gases and vapours within the operating workspace; and musculoskeletal factors due to poor ergonomic design of equipment and controls.

DP 7: Manual tasks

The objective is to prevent harm due to manual tasks during installation, maintenance and operations of equipment, to as low as reasonably practical, including consideration in design for foreseeable human error. For example, musculoskeletal injury from exposure to risk factors such as forceful exertion, awkward or static posture, repetition or prolonged duration, and hand-arm and/or whole-body vibration due to manual tasks associated with installing, operating and maintaining the equipment.

DP 8: Confined spaces and restricted work areas

The objective is to prevent harm to people working in confined spaces and restricted work areas to as low as reasonably practical, including consideration in design for foreseeable human error. For example, asphyxiation from irrespirable atmosphere due to lack of adequate ventilation.

INDUSTRY LEVEL PROJECTS

EMESRT takes a structured approach to project establishment and management. It rigorously defines and documents the problem, prepares an industry project landscape, identifies key stakeholders, builds project communities through subject-focused technical working groups, coordinates resources, and articulates project deliverables.

Each EMESRT industry project has a defined objective and is led by an advisory group member on a volunteer basis. The project lead is responsible for achieving specified outcomes and driving the strategic direction of the technical working group.

A formal project management methodology is used for all EMESRT industry projects. This, along with the control framework approach, provides users with practical results.

At the end of 2023, EMESRT was leading three active industry-level projects, each with an established technical working group working on predetermined project objectives.

The sections that follow in this report provide a summary of each project.

CONTROL FRAMEWORK APPROACH

EMESRT developed the control framework in 2017. Since then, EMESRT has refined its Control Framework approach, which is now a core operational process used for all industry projects.

The control framework is a highly iterative and adaptive process that begins with asking; *what has to be in place for the work to go right?*

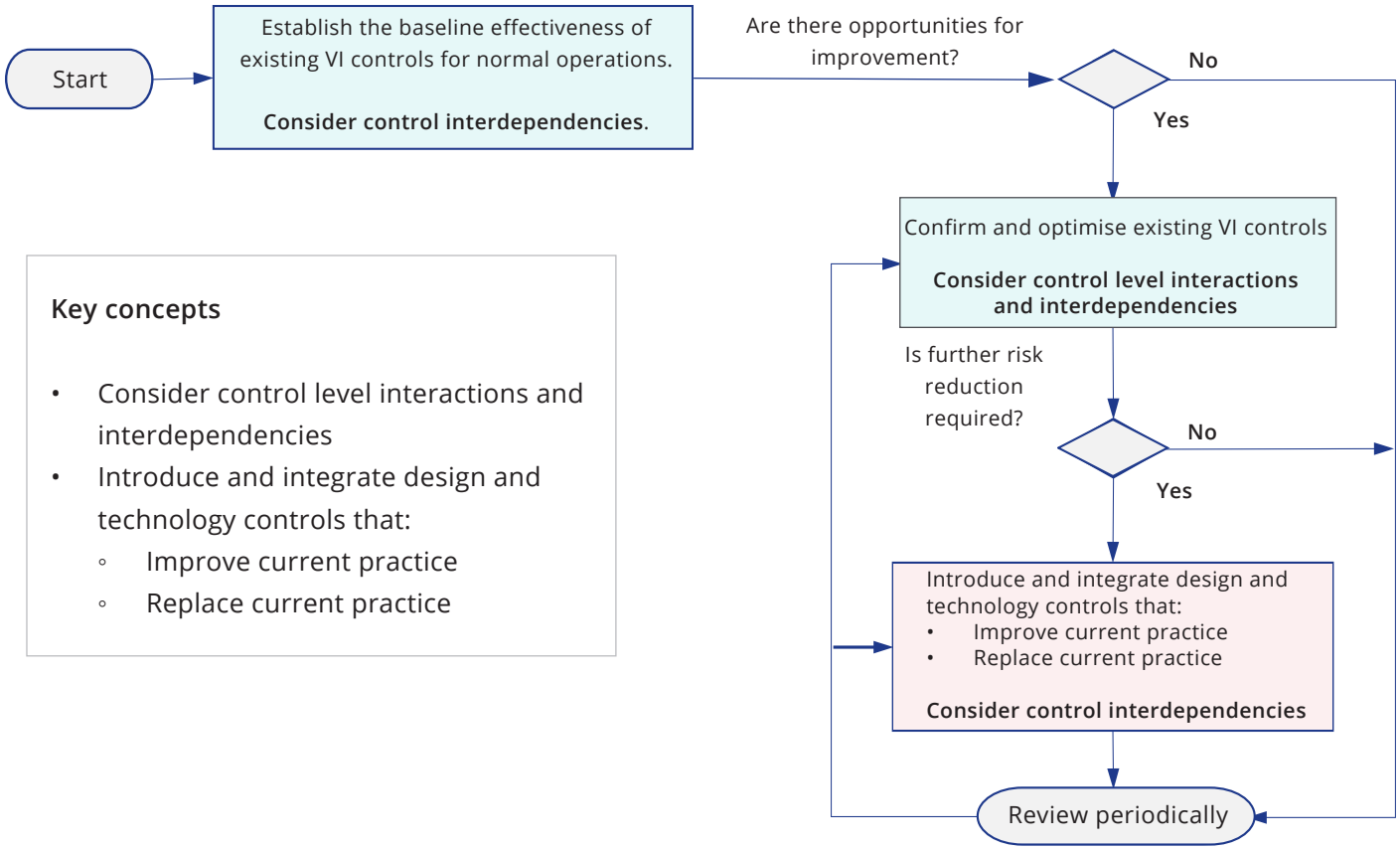


Figure 2: EMESRT VI Control Framework assessment model.

INDUSTRY PROJECT 1 VEHICLE INTERACTION

Project objective: to improve the effectiveness and reliability of vehicle interaction controls in mining.

This industry project is led by Glencore representative Tony Egan and Anglo American representative Matthew Clements.

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.

THIS INDUSTRY PROJECT

EMESRT has been working on the Vehicle Interaction (VI) topic since 2013. 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 to all or part of the problem.

EMESRT first turned its attention to vehicle interaction in 2007 when it published Design Philosophy 5 (DP-5), focusing on machine operation controls.

DP-5 objective is to prevent harm, during machine operation and control, to as low as reasonably practical, including consideration in design for foreseeable human error.

This EMESRT industry project builds on the indicative design problem information in DP-5 and is a more definitive extension of the original work carried out in developing the design philosophy.

The Technical Working Group (TWG) members are actively involved in the project and provide their time, expertise, knowledge and experience to EMESRT on a volunteer basis. They contribute to monthly meetings, webinars, workshops, one-on-one discussions, and the development of industry resources. The EMESRT advisory group members appreciate and acknowledge their contribution.

The project leads provide strategic direction to the vehicle interaction control improvement TWG, which consists of a broad range of industry stakeholders and, at the time of publication, includes 206 members representing 64 global organisations.

THE COMPELLING CASE – VEHICLE INTERACTION CONTROL IMPROVEMENT PROJECT

Vehicle interaction: the dynamic relationship between vehicle to person, vehicle to vehicle, and vehicle to equipment or environment.

The effectiveness of these interactions plays a pivotal role in determining safety, asset integrity, efficiency, and productivity levels. Each element influences the other, creating a complex, interconnected environment.

EMESRT has identified industry-level opportunities:

- Share experience and know-how to develop a common and structured understanding of the issues and opportunities
- Use common problem definitions and functional performance scenarios to assist Original Equipment Manufacturers (OEM's) and third-party Proximity Detection System (PDS) designers in developing industry-level solutions
- Confirm **react** and other technology innovation opportunities that will improve or replace what we do now
- Identify and share **design** and **operate** innovation opportunities
- Develop aligned processes that assist with the operational integration of react and other technology innovation opportunities

Expanding the 'common voice' on key industry problems provides designers with motivation to change.

Mining industry fatality experience tells us that no organisation has reliably sustained vehicle interaction 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.

ICMM LEADING SITES INITIATIVE

This Leading Sites initiative aims to improve the mining industry's vehicle interaction 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 initiative is its partnership with EMESRT.

The initiative 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 initiative is the Capable Solution definition, which sets out three key principles of a VI improvement program.

In late 2021 and throughout 2022, a broad-reaching strategy was established through a series of consultative engagements.

In October 2022, ICMM/EMESRT brought mining users, OEM's, third-party technology providers, researchers, and other industry experts together. This initial four-day workshop had 77+ participants who reviewed and tested the validity of the package of vehicle interaction improvement resource materials developed, which start with a way to look at underlying control effectiveness as part of the ecosystem that technology integrates into.

This is where all the knowledge resources related to the Vehicle Interaction Control Improvement program developed by EMESRT were introduced to users through a practical workshop. The challenge for the stakeholder group was to determine the relevance of the materials to address the problems and provide feedback on enhancements to those materials. The resounding output from participants was that the material is a very useful piece of work, or piece of information, that will allow the industry to move forward on its improvement goals. The basis for the Leading Sites program was established following the endorsement of the resource materials.

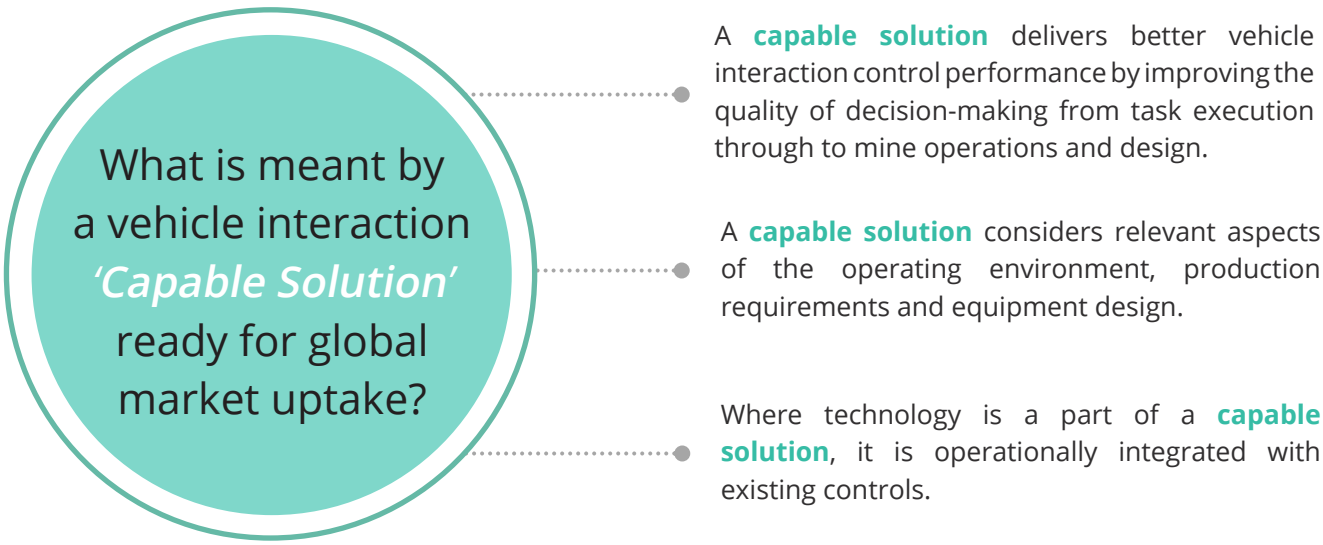


Figure 3: ICMM ICSV VI leading sites program capable solution.

In 2023, the first two Leading Sites workshops were held in Brisbane, with ICMM and EMESRT member company representatives involved. Following the first workshop, a monthly online forum was established where workshop participants shared their experiences and provided feedback on progress, both positive and negative learnings.

A further workshop is planned for June 2024 in Tucson, Arizona to allow northern hemisphere attendees easier access.

THE EMESRT VEHICLE INTERACTION CONTROL FRAMEWORK

Using the EMESRT Control Framework (CFw) approach, the TWG confirmed the required operating states that need to be in place to provide consistent, safe, and productive mining operations that also prevent and mitigate vehicle interaction hazards.

This CFw presents industry-validated failure modes and the business inputs that should be in place to prevent a required operating state from being compromised. It provides both a 'whole-of-system' overview and detailed information about the dynamic interconnects between personnel, equipment, the work environment, workgroups carrying out different tasks, and overall coordination.

Furthermore, the CFw promotes the systematic identification of improvement opportunities.

Table 1: Vehicle interaction required operating states.

REQUIRED OPERATING STATE		INTENT
ROS-01	Operator maintains adequate clearances/ distances.	Minimise potentially hazardous interactions between vehicles, co-workers or other items/equipment/structure/environmental aspects when operating and traveling along roadways. Nil approach contact; vehicle to vehicle, vehicle to person(s), vehicle to equipment or environment.
ROS-02	Vehicle operators give way appropriately to mobile plant and pedes-trians.	Minimise potentially hazardous interactions between mobile plant and mobile plant and pedestrians in work areas - particularly at constructed intersections and where traffic flows come together.
ROS-03	Operators drive vehicles at speeds which meet site rules and local conditions.	Reduce the potential for loss of control of equipment due to incorrect speed for the conditions. Nil loss of control of equipment caused by incorrect speed for the conditions.
ROS-04	Operators do not drive vehicles when impaired.	Operators maintain control of equipment and do not drive when, due to operator impairment through fatigue, stress, alcohol and other drugs, or work environment stressors they are more prone to make mistakes.
ROS-05	Operators park vehicles in positions that avoid unwanted interactions.	Minimise potentially hazardous interactions between vehicles, co-workers or other items/equipment. No unintended movement of parked vehicles.

Table 1: Vehicle interaction required operating states, *cont...*

REQUIRED OPERATING STATE		INTENT
ROS-06	Physical barriers provide separation.	Physical barriers minimise interactions between vehicles, co-workers, other items, or equipment. Nil normal operations contact; vehicle to vehicle, vehicle to person(s), vehicle to equipment or environment.
ROS-07	Alarms alert operators to nearby hazards and operator takes appropriate action.	Minimise potentially hazardous interactions between vehicles, co-workers or other items/equipment. Alerting alarms or laser barrier/fencing provides timely information on nearby hazards and the vehicle trips and/or vehicle operator responds appropriately. The goal is to achieve Nil approach contact; vehicle to vehicle, vehicle to person(s), vehicle to equipment.
ROS-08	When a vehicle component alarms the operator responds appropriately.	Critical vehicle component e.g., brake or steering system warning alarms. Reduce the potential for loss of control of equipment due to loss or failure of brake or steering system. The vehicle operator responds appropriately to brake or steering system alarms. Nil loss of control of equipment caused by loss or failure of brake or steering system.
ROS-09	Loads are appropriate for vehicle type and site conditions; items are secured during travel.	Vehicle operator or worker loads the vehicle appropriately for site conditions, including securing items. Low levels of harm caused loose objects or loading issues during any vehicle interactions.
ROS-10	Access control - vehicle operators limit movements/activities to designated areas.	Access controls minimise potentially hazardous interactions (vehicle to vehicle, vehicle to pedestrian) in operational areas.
ROS-11	Seat belts are used by vehicle operators and occupants.	To minimise level of harm which results during a hazardous vehicle interaction - Workers traveling in vehicles fitted with restraints wear them when the vehicle is in motion. Vehicle operator and passengers use seat belts / restraints. Maximum designed operator protection during any hazardous vehicle interaction.
ROS-12	Cabin protection is to site standards.	Maximum designed operator protection during unwanted vehicle interactions. For surface operations consider the use of airbags.
ROS-13	Emergency responders manage injuries at the scene.	Adequately resourced site emergency services respond in a timely manner to minimise the injuries or losses sustained at the accident scene. For major, ongoing situations external emergency services - who are familiar with site conditions - provide back up support to limit the extent of loss. Timely response that removes people from danger, stabilises injuries and provides transport for further treatment.

FUNCTIONAL PERFORMANCE SCENARIO STORYBOARDS

The storyboard approach was first developed in 2019 by an EMESRT member company for surface operations and then adopted by EMESRT to provide surface technology designers a clearer understanding of the fatal scenarios involving mobile equipment at surface and underground mines.

The storyboards provide a visual and dynamic reference for equipment operators, technology system suppliers, and vehicle control improvement managers as they implement vehicle interaction control improvements.

A need for underground scenario storyboards was noted at the October 2022 stakeholder workshop, leading to the creation of an underground functional performance scenario storyboard sub-group in 2023. A preliminary set of storyboards centered on five identified fatal scenarios were created following extensive industry consultation.

The storyboards are intended to be used by individual operations when communicating with a technology solution provider about developing specific configured solutions for their operations.

Further consultation will be undertaken in early 2024 by encouraging users to engage with technology providers and 'road test' the materials. The underground storyboards will be finalised during an industry workshop of stakeholders in April 2024 and published shortly thereafter.

In parallel, the EMESRT Performance Requirement 5A: Vehicle Interaction Systems is being revised to include the final underground storyboards. The surface storyboards published in 2019 will be reviewed and updated in line with the learnings from the underground work.

PROJECT NEXT STEPS

- Continue to collaborate with the ICMM ICSV VI Leading Sites program to influence users and designers around the globe
- Update and distribute vehicle interaction control improvement resources and materials
- Translate the improvement resource materials into four languages (French, Portuguese, Russian and Spanish)
- Finalise and publish the underground functional performance scenario storyboards
- Parallel with the underground storyboard development, review and update the surface functional performance scenario storyboards where/if appropriate
- Revise and publish the updated Design Philosophy 5: Machine Operation and Controls
- Revise and publish the EMESRT vehicle interaction 9-layer defensive control model initially published in 2015
- Progress the development of the Proximity Detection System Validation Framework guideline into an industry resource and propose a project development with the ISO Standards committee
- Develop and launch the VI Body of Knowledge platform
- Continue Control Framework updates when there is new incident information

SUMMARY

The EMESRT industry project approach is based on system-level understanding, engineering logic, and wide engagement and focus on outcomes.

In 2024, EMESRT is in the delivery phase of the vehicle interaction improvement strategy. These industry-level projects are complex, and the many moving parts need to be managed; there are no technology silver bullets.

Through proactive engagement and clear problem definition for design improvements, EMESRT is making an impact.

For more information regarding this industry project please visit the EMESRT website.

INDUSTRY PROJECT 2 TYRE AND RIM MANAGEMENT

Project objective: to provide tyre and rim designers and users with structured information that enables the prevention and the mitigation of the consequences of unwanted tyre and rim events.

This industry project is led by Glencore representative Tony Egan.

INTRODUCTION

Mining operations rely heavily on the use of large mobile equipment, which includes trucks, loaders, excavators, attachments, etc. The equipment plays a crucial role in the extraction and transportation of valuable minerals. However, one of the significant challenges faced in the mining industry is the effective management of tyres and rims.

Tyre handling and maintenance of large earthmoving tyre assemblies is the second most significant source of fatal events in surface mining operations after unwanted vehicle interactions.

Tyre and rim events:

- Present significant fatality exposure for tyre maintenance technicians, mobile equipment operators, mobile equipment maintainers, and emergency responders
- Are formally reported in most mining jurisdictions, event patterns, and prevalence, and have been extensively analysed and reviewed
- Regulators expect that mine operators can improve performance

Statistics indicate people from all sectors of the mining industry globally continue to suffer serious injury or death from unwanted incidents when maintaining large earthmoving tyre assemblies, mostly in stored energy or crush-type scenarios, i.e., sudden release of energy from inflated wheel assemblies as a result of incorrectly fitted rim components, tyre bursts or fires resulting from excessive heat build-up, and crush injuries when working in or around tyre handling equipment.

These incidents are preventable. The industry needs to identify the problems in designs for large tyre and rim handling equipment that lead to the potential for human error, implement leading practice tyre management procedures, and develop recognised skill competencies for people involved in maintaining and supervising tyre-related maintenance tasks.

THIS INDUSTRY PROJECT

Following a series of significant incidents in EMESRT member companies, the EMESRT Advisory Group members committed to facilitating an industry project to improve tyre and rim management.

This decision was based on the following drivers:

- Significant fatality exposures for tyre maintenance technicians, mobile equipment operators, mobile equipment maintainers, and emergency responders
- Inadequate maintenance and operational practices causing early service failures incur considerable costs, e.g., repair or replacement of damaged tyres, unavailability of equipment, etc
- There are increasing expectations that mine operators can improve performance
- The range and complex interdependency of the business inputs necessary for safe and productive operations using rubber-tyre earth moving equipment

EMESRT first turned its attention to tyres and rims in 2007, when it published Design Philosophy 2, focusing on tyres and rims.

Design Philosophy 2 provides visual operational scenario information for designers of wheel assembly components and mining operators. It has this objective: *to provide tyre and rim designers and users with structured information that enables the prevention and the mitigation of the consequences of unwanted tyre and rim events.*

This EMESRT industry project is an extension of the original work carried out in developing the design philosophy.

EMESRT takes a structured approach to project establishment and management. It rigorously defines and documents the problem, prepares an industry project landscape, identifies key stakeholders, builds project communities through subject-focused technical working groups, coordinates resources, and articulates project deliverables.

The Technical Working Group (TWG) members are actively involved in the project and provide their time, expertise, and experience to EMESRT on a volunteer basis. They contribute to monthly meetings, webinars, workshops, one-on-one discussions, and the development of industry resources. The EMESRT advisory group members appreciate and acknowledge their contribution.

The project leads are supported by the TWG, which consists of a broad range of industry stakeholders and, at the time of publication, includes 67 members representing 28 organisations. The group meets on a regular basis to further progress this industry project.

Tyre and rim management is a complex problem, and EMESRT recognised that further problem definition work was required. Industry researchers were engaged to provide a better understanding of the human factors aspects of the tasks and environment.

EMESRT recognised that there were areas of activities that were not fully understood and , as such, supported the researcher's engagement and was the catalyst behind several rounds of research funding approved by the Australian Coal Industry's Research Program (ACARP), a unique and highly successful mining research program that ACARP has been running in Australia since 1992.

In 2023, the ACARP board approved further funding of $360k for Project C35020 - *Human-Centred Interactive Hazard Experiences in Off the Road (OTR) Tyre Handling.*

The project's objective is to support safety in off-the-road tyre handling operations and equipment design innovations by translating real-world high-consequence, material unwanted events (like direct and indirect equipment interactions that result in fatalities) into high-fidelity, interactive hazard awareness experiences.

The existing training pathways vary, and the education methods for off-the-road tyre servicing do not uniformly or adequately address these safety-critical events. Further, equipment and system designers can benefit from learning about these circumstances. This has been identified by the EMESRT Tyre and Rim Technical Working Group. This is important because these tasks can lead to catastrophic and fatal events, and tyre fitters are among the highest-fatality occupational groups in maintenance and trade roles in mining.

THE EMESRT TYRE AND RIM CONTROL FRAMEWORK

Tyre handling equipment is used for earthmoving equipment for road tyres and assembly, to manage inventory, change assembly, change tyres, and for travel and storage. The equipment involves a prime mover and attachments like arms and grab pads.

The equipment design and operational demands result in credible failure modes that require management. These credible failure modes include unplanned releases of loads, e.g., tyre assembly, machinery that contacts workers or other equipment, rapid deflation, and sudden wheel rim disassembly.

The results can involve direct or indirect interactions with humans or equipment that can lead to fatalities, disablement, and capital loss.

The EMESRT control framework approach has a strong human factors analysis element. It allows real-world inputs and experiences to be mapped to the safe and productive operating states required to deliver business purposes.

The Required Operating States (ROS) listed in Table 2 (Page 32) is the minimum set necessary for consistently safe and productive mining operations working with rubber-tyre mobile equipment.

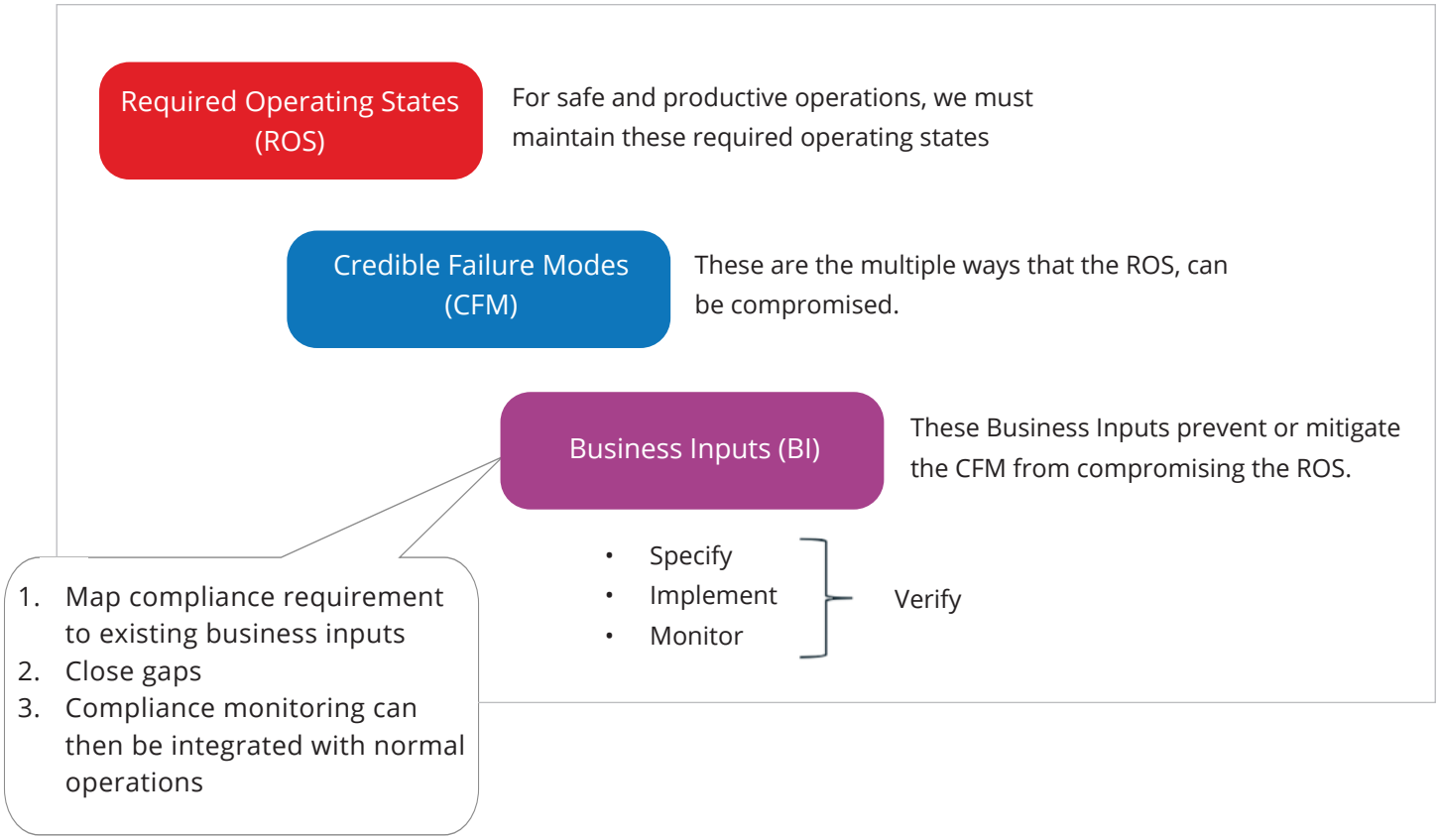


Figure 4: The hierarchy and components of a control framework.

Table 2: Tyre and rim required operating states.

REQUIRED OPERATING STATE		INTENT
ROS-01	Tyre maintenance practices for load shifting, component storage and mobile equipment interactions are effectively managed.	Tyre maintenance load shifting, component storage and mobile equipment interactions are safe and productive: ▪ Clearances between mobile equipment and pedestrians are maintained ▪ Clearances between fixed equipment and personnel are maintained ▪ Lifting and load shifting is well planned and carried out without losing control ▪ Tyres and wheel assemblies are stored correctly so they cannot fall or roll ▪ Movements of tyres and other wheel assembly components are managed at all phases of their operating lifecycle from manufacture through to disposal ▪ Tyre maintenance includes Earth Moving Equipment as defined in Australian Standard AS 4457 as well as other rubber tyre vehicles such as highway trucks, light vehicles, cranes, etc.
ROS-02	Wheel assemblies remain intact, and equipment performs to expectations during tyre changes and all other tyre and rim maintenance activities.	Wheel assemblies remain intact and there are no unintended equipment failures through the tyre and rim maintenance cycle: ▪ Removal from equipment ▪ Disassembly ▪ Reassembly ▪ Mounting to equipment ▪ Inflation to operating pressure ▪ In-service tyre inspections including reinflation ▪ Personnel are always protected from high-energy and/or pressure related failures of wheel assemblies and associated equipment
ROS-03	Safe and productive operational use of earth moving equipment with inflated rubber tyres.	Operational personnel understand and make relevant contributions to ensure safe and productive tyre management through ensuring that: ▪ Operating conditions minimise tyre damage ▪ Equipment operating practices meet and/or extend tyre life ▪ Tyre pre-start inspection requirements are clear and applied ▪ Operating personnel know how to manage high-energy wheel assembly failure situations e.g., fires, HV wire contact and lightning strike
ROS-04	Tyre recycling and disposal practices for load shifting, storage, mobile equipment interactions and interaction with plant are effectively managed.	Tyre recycling and disposal practices for load shifting, storage, mobile equipment interactions and interaction with plant are effectively managed: ▪ Clearances between mobile equipment and pedestrians are maintained ▪ Clearances between fixed equipment and personnel are maintained e.g., through guards and interlocks ▪ Lifting and load shifting is well planned and carried out without losing control ▪ Tyres are stored and transported so they cannot fall or roll
ROS-05	Tyre maintenance, repair, reconditioning, recycling and disposal practices do not compromise the health of the people undertaking the work.	Tyre maintenance, repair, recycling and disposal practices do not cause health issues for the people involved.

Using the control framework approach establishes both a 'whole of system' overview and a structure that is linked to detailed operational practice. Working this way provides information and insights about the dynamic inter-connects between personnel, equipment, the work environment, workgroups carrying out different tasks, and overall coordination. This promotes the systematic identification of improvement opportunities.

It is a flexible approach that allows the ongoing updating of all control framework component descriptions, content, and links as new information becomes available and new insights develop.

In early February 2023, a tyre handler one-day workshop was held in Brisbane with technical working group sub-group members. The sub-group are experts in the field and offer expertise and experience in tyre handling. The aim of the workshop was to enhance a learning experience about scenario-based credible failures and resilient work practices or design implications.

A further two-day workshop was held in September 2023 in Brisbane and attended by 15 technical working group members. The primary focus of the two-day workshop:

1. Verification and validation
2. Digital technology to transform operations

Workshop participants reviewed key findings of the ACARP Project C33005 (three phases): Human factors aspects of tyre handling equipment design and operation examined within an EMESRT Control Framework approach, and the ACARP Project C35020: Human-centred hazard education in OTR tyre handling per the EMESRT Control Framework that is in progress.

WORKSHOP DAY ONE

On day one, participants discussed the 15 workflows of tyre handling with the 17 repeated tasks in which credible failure modes can lead to unwanted events, the permutations of tyre handling equipment, and tyre grab configurations.

The discussions also included the general work demands on tyre fitting technicians, systems of work, environment, task, and design of equipment causing workers to position themselves close to the heavy mobile plant and OTR tyres during the main tyre and assembly handling tasks.

During the workshop, participants worked in small groups and used rank-scoring voting to nominate four scenarios that were advanced for consideration and production:

1. Carrying a worn or totally damaged tyre
2. Carrying stacked tyres
3. The manipulator bumps equipment off the stand
4. Putting chains on or off an OTR tyre

Further workshops will be scheduled in early 2024 to discuss, finalise and publish the additional four scenarios listed above to the EMESRT Body of Knowledge platform.

WORKSHOP DAY TWO

Participants reviewed the bespoke technology, the interactive product viewer (Figure 1), developed by a third-party supplier to convert the animated scenarios into a hazard education module.

Workshop participants formed small groups to review each of the 17 scenarios and usability features of the software and provide feedback on the user interface and content.

An overview of the visual remote guidance headwear was provided to participants to prompt consideration of its potential use in the next phase of the project.

The group indulged in general ideation but deferred further discussion to future workshops.

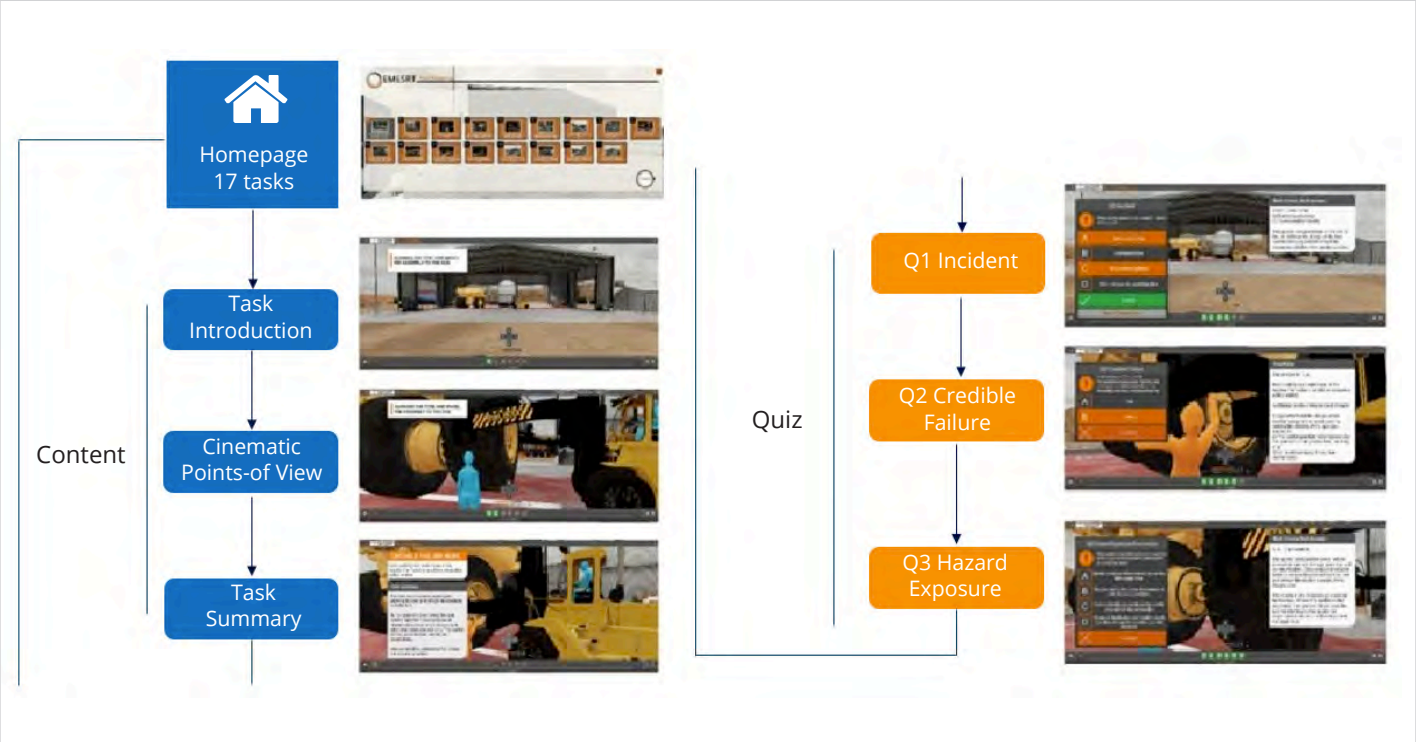


Figure 5: Interactive product viewer hazard education conventions.

PROJECT NEXT STEPS

- Finalise and publish the four additional tyre handler scenario storyboard animations based on tasks identified
- Finalise and publish the interactive product viewer, hazard education facilitator, and learner guides
- Site visits to evaluate the interactive product viewer with tyre technicians
- Publish the ACARP Project C35020 Final Report
- EMESRT will make available Android tablets (on loan) with 21 interactive scenarios and human-centred hazard education resource materials for industry to test and provide feedback
- Commence tyre and rim management control effectiveness baseline mapping at EMESRT member sites
- Conduct tyre handler equipment failure mode, effects and criticality analysis with key stakeholders on the range of prime movers and the range of related gripping attachments, this will include not only the mechanical or control aspects but also have a strong focus on identifying potential areas of exposure through human error
- Finalise and publish the updated Design Philosophy 2: Tyres and rims
- Develop and publish the Tyre and Rim Management Improvement Project Guide, including work breakdown structure and guidance notes
- Develop and launch the Body of Knowledge platform
- Continue Control Framework updates when there is new incident information
- Contribute towards the draft AS 4457: Off-highway rims and wheels – Maintenance and repair standard

SUMMARY

Tyre and rim management, in particular tyre handling, pose significant challenges to the mining industry. However, substantial improvements can be achieved through a combination of sound work protocols, systems and skilled and experienced personnel.

Tyre handlers and their attachments need to be fit-for-purpose and be well maintained. The design, layout and location of the tyre handling work bay is also important.

For more information regarding this industry project please visit the EMESRT website.

INDUSTRY PROJECT 3 MOBILE EQUIPMENT FIRE MANAGEMENT

Project objective: to eliminate or mitigate the consequences of unwanted fire events by providing industry stakeholders with structured information that enables the prevention fire initiation and timely activation of suppression systems.

This industry project is lead by Rio Tinto representative Mark Geerssen and Alcoa representative Peter Hasler.

INTRODUCTION

Mobile equipment fires continue to occur frequently in the mining and resource industries. The impact of mobile equipment fires can lead to serious injuries or fatalities for operators, maintainers, and emergency responders.

Fire events can result in substantial damage or total loss of equipment, significant downtime, and ultimately impact the productivity and profitability of mining operations. Fires in underground mining operations can have wider catastrophic consequences.

WHAT CAUSES MOBILE EQUIPMENT FIRES?

Primarily, these fires are initiated due to mobile equipment design inadequacies, errors in maintenance, fire detection or suppression system design inadequacies, and activation failures. Commonly, fires are initiated when fuel or hydraulic fluid leaks are in close proximity to exposed ignition sources. In some cases, human errors may also contribute to these fire events, e.g., oily rags left in the engine bay.

THIS INDUSTRY PROJECT

EMESRT recognised the need for mobile equipment fire hazards to be controlled through appropriate designs and management practices. In turn, regulators are requiring mandatory statutory reporting in most mining jurisdictions and now expect that mine operators will improve their mobile equipment fire management resulting in lower levels of incidents.

Following an EMESRT advisory group discussion in 2018 on a fire incident that occurred in an EMESRT member company underground operation that could have had a catastrophic consequences, the improvement project was established.

In 2007, EMESRT first sought to turn its attention to mobile equipment fires. As a result, EMESRT published Design Philosophy 4 focussing on fire.

Design Philosophy 4 provides visual operational scenario information for equipment designers and mining operators. Its objective is to prevent harm related to equipment fires to as low as reasonably practicable, including consideration in design for foreseeable human error.

The intended design outcome should include:

- Elimination of sources of ignition and fuel
- Protection of the operator should fire occur
- Automatic suppression of fire
- Automatic engine shutdown and isolation of fuel sources, should fire occur
- Manual suppression of the fire should auto suppression be inadequate

However, due to an evolving understanding of the complex and dynamic issues involved, this EMESRT industry project is an extension of the original work carried out in developing the design philosophy.

EMESRT takes a structured approach to project establishment and management. It rigorously defines and documents the problem, prepares an industry project landscape, identifies key stakeholders, builds project communities through subject-focused technical working groups, coordinates resources, and articulates project deliverables.

The Technical Working Group (TWG) members are actively involved in the project and provide their time, expertise, and experience to EMESRT on an in-kind basis. They contribute to monthly meetings, webinars, workshops, one-on-one discussions, and the development of industry resources. The EMESRT advisory group members appreciate and acknowledge their contribution.

The project leads provide strategic direction to the TWG, which consists of a broad range of industry stakeholders and, at the time of publication, includes 84 members representing 49 global organisations.

Validating your baseline control effectiveness provides a clear plan for improvement.

Using the heat, fuel and oxygen fire triangle, the TWG discussed and documented five event areas of influence using the Control Framework approach. This process unearthed five areas of influence:

1. Mobile equipment design
2. Mobile equipment maintenance
3. Fire system detection and suppression design
4. Operation*
5. Local and emergency response*

**Local and site emergency response is out of scope for this project. However, initial operational response to fires, asset operation and site emergency response capability remain relevant to effective mobile equipment fire management.*

Based on the above areas of influence, the TWG developed Performance Requirement 4 (PR-4): Mobile Equipment Fire Management, first published in 2021.

It is recommended that DP-4 and PR-4 be read in concert. Together, they provide structured and comprehensive information for mobile equipment designers, mine operators, fire detection and suppression system designers, and third-party suppliers and maintainers. PR-4 was published following several iterations and one-on-one meetings with designers.

THE EMESRT FIRE CONTROL FRAMEWORK

Using the EMESRT control framework approach, the TWG identified the required fire related operating states that provide consistent, safe, and productive mining operations.

This control framework presents industry-validated failure modes and the business inputs that should be in place to prevent a required operating state from being compromised. It provides both a 'whole-of-system' overview and detailed information about the dynamic interconnects between personnel, equipment, the work environment, workgroups carrying out different tasks, and overall coordination.

Furthermore, the control framework promotes the systematic identification of improvement opportunities.

These required operating states address:

1. Equipment design that prevents interactions between flammable materials and ignition sources
2. Maintenance schedules and standards that include specific fire prevention and mitigation checks
3. Mobile equipment that operates within design limits
4. Effective local responses to fires and potential fires
5. Effective emergency responses

Table 3: Mobile equipment fire management required operating states.

REQUIRED OPERATING STATE		INTENT
ROS-01	Mobile plant design prevents interactions between flammable materials, fuel and ignition sources.	The design of mobile equipment should: ▪ Separate all potential fuel sources from ignition sources ▪ Secure and contain liquid fuel sources ▪ Eliminate solid fuel sources ▪ Separate, shield or protect hot surfaces so they cannot ignite fuel Mobile equipment should include systems that: ▪ Detect and mitigate any the loss of any combustible liquid ▪ Detect actual or potential fires situations and provide shutdown and suppression systems Additional design elements may be required for underground applications including removing, as far as is practicable, flammable materials such as non-metallic parts and paints.
ROS-02	Fire Detection and Suppression System (FDSS) design and installation is fit for purpose.	Fire detection and suppression system design and installation: ▪ Is well coordinated between OEM and Fire System suppliers ▪ Assesses minimum system capability for operator escape in all likely mobile equipment fire scenarios ▪ Assesses minimum system capability required to extinguish all likely mobile equipment fires ▪ Is supported by information provided to the mobile equipment owner and fire system maintainers
ROS-03	Mobile plant is maintained to a schedule and to OEM standards. Specific fire prevention and mitigation checks are part of the maintenance process. There are no early operational failures.	Mobile equipment is maintained to OEM standards and schedule based on duty requirements and the operating environment. This includes the maintenance of third-party modifications such as equipment fire and suppression systems. Maintenance tasks are well planned and executed e.g. hot work. Maintenance processes include quality checks before equipment is returned to service.
ROS-04	Mobile plant is operated productively and safely within operating design limits, avoiding fire or potential fire incidents.	Mobile equipment is operated within design limits to avoid: ▪ Overheating components leading to fires ▪ Component faults or failures that release liquid fuel
ROS-05	Maintenance activities on or around mobile equipment do not cause fires.	Hot work on or around mobile equipment does not cause fires on mobile equipment, maintenance infrastructure, or in the general work environment.
ROS-06	Mobile Equipment Fire conditions are detected and managed before a fire occurs.	The circumstances that lead to mobile equipment fires during operations are well defined and actively monitored. The fire potential status of operating mobile equipment is continuously assessed and pre-determined actions (alerts, alarms and advice) are applied as designed.
ROS-07	Local Response to fires or potential fires on mobile equipment - early detection with effective local response.	Mobile equipment operators and other workers are trained and capable of responding to mobile equipment fires. Training includes following site emergency protocols, if the fire cannot be extinguished.
ROS-08	Effective Emergency Response beyond local response limits fire losses.	If there is a fire of potential fire on or around mobile equipment, there is an effective emergency response that protects lives and property.

Using the control framework approach establishes both a 'whole of system' overview and a structure that is linked to detailed operational practice. Working this way provides information and insights about the dynamic inter-connects between personnel, equipment, the work environment, workgroups carrying out different tasks and overall coordination. This promotes the systematic identification of improvement opportunities.

It is a flexible approach that allows for updating of all control framework component descriptions, content, and links as new information becomes available and deeper insights develop.

In early 2023, EMESRT developed a strategy to engage with OEM's face-to-face and online. The aim of the engagement strategy was to share and get alignment on several key fire mitigation design opportunities for reoccurring fire events, such as:

- Vulnerability of existing fluid supply mechanisms
- Use of flammable materials in existing energy drive, and associated construction systems
- Designs that allow flammable material build-up
- Integration of fire suppression system logic through isolation, anticipation, detection, actuation, reporting, alarming, prioritisation, human systems integration, etc.
- Inability of fire suppressants to extinguish certain flammable materials
- Emerging energy-drive systems
- Designs that prevent incorrect assembly or installation

PROJECT NEXT STEPS

- Continue engagement with OEM designers to provide an understanding of the potential unwanted events
- Focus on OEM equipment design improvement opportunities for fire prevention or mitigation
- Continue Fire Management Control Effectiveness Baseline validations at EMESRT member sites
- Finalise and publish the updated Design Philosophy 4: Fire
- Develop and publish the Mobile Equipment Fire Management Project Improvement Guide, including work breakdown structure and guidance notes
- Develop and launch the Fire Management Body of Knowledge platform
- Continue resource material updates when new incident information becomes available

SUMMARY

Mobile equipment fires are a significant hazard in the mining industry. However, fires on mobile plant are preventable, every fire event has the potential to get out of control and can cause serious injury, fatality and extensive financial loss.

For more information regarding this industry project please visit the EMESRT website.

FURTHER DETAILS ON HOW EMESRT OPERATES

GOVERNANCE FRAMEWORK

Whilst EMESRT is not a registered entity, it is committed to ensuring that its practices reflect good governance.

EMESRT aims to deliver practical outcomes at an industry level, with a work program that involves delivering specific projects. EMESRT's Advisory Group (EAG) members, who are senior managers in their respective organisations, make contributions based on their availability, experience and expertise.

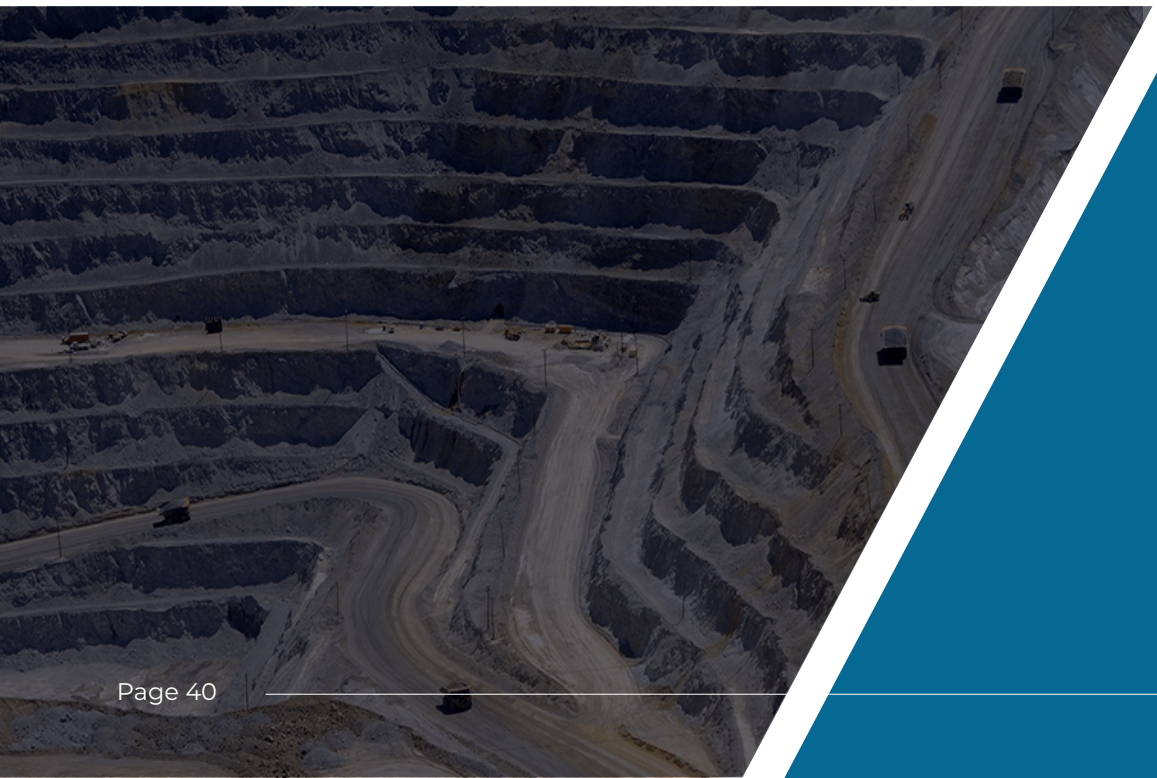
Secretariat and financial management support is provided on a fee-for-service basis by a third-party provider.

Expert consultant support is sourced as required.

FUNDING

EMESRT membership is open to mining companies and the members provide the direct funding for EMESRT activities through an annual membership fee. The fee is set based on a 24-month rolling activity and project plan, which is reviewed annually.

Significant value is contributed from the in-kind involvement of all stakeholders in the many related project activities. This includes coordinating and connecting work already in progress by other organisations. Indirect funding is accessed via groups such as ACARP's coal industry research, university research, and other technical research and development conducted by other organisations.



ACTIVITIES SCOPE

EMESRT seeks to foster candid dialogue, transparent industry-level collaboration, open sharing of non-commercial information, and active stakeholder engagement.

The EAG is aware of managing anti-trust issues and clearly communicates EMESRT's scope in all workshops and other industry forums. This process has been in place since OEM engagement work commenced in 2006.

In scope; EMESRT **will**:

- Focus on the design of earth moving equipment in surface and underground mines
- Provide aligned design expectations based on hazards
- Involve interested mining companies in the industry
- Share openly with all interested OEM's and other third-party suppliers
- Listen, consider and value OEM and third-party supplier contributions
- Provide information on leading practice to OEM's and third-party suppliers
- Share leading practice to assist mining equipment users in achieving health, safety and environmental compliance goals

Out of scope; EMESRT **will not**:

- Discuss commercial issues or anything of an anti-trust nature
- Provide approval for OEM or third-party designs
- Share OEM confidential information with other OEM's or third-party suppliers
- Impose adoption of solutions on member company sites

ANNUAL WORK PLAN

The EAG meets annually to discuss the progress of current projects, review and amend the strategic plan, and document future focus areas.

The work plan process includes:

- Reviewing the progress of current industry projects (including outstanding activities and the potential end date)
- Identifying prevalent industry issues that members are highlighting
- Structuring responses that are within EMESRT's stated scope of operation
- Appointing project lead(s)
- Confirming the strategy and plans
- Setting timelines and allocating resources
- Allocating budget(s)
- Determining the following year's membership fees based on the identified work plan and allocated budget

The EAG establishes a TWG for each project. Each TWG includes multiple member representatives, OEM's, third-party suppliers, industry experts and others with relevant expertise. The EAG and TWG's meet regularly to discuss the progress of each industry project.

CONTINUITY AND RENEWAL

One of EMESRT's significant strengths is the continuity of its representatives from member organisations. A core group of company representatives were responsible for establishing EMESRT and have remained involved.

Each has made significant contributions to developing the reach and profile of EMESRT and supported the evolving operational processes that can deliver successful industry-level projects. Importantly, they have established and maintained good relationships with senior managers in OEM's and industry third-party supplier organisations.

One of the most important challenges facing EMESRT is capturing the core representatives' decades of effective work so EMESRT can continue beyond its original cohort of pioneers. Meeting this challenge has required formalising and updating EMESRT's operational processes as well as documenting the journey of current and past projects to provide insights into the activities that made a real difference in improving outcomes for users.

The effectiveness of EMESRT's approach for engaging with and influencing organisational decision-makers is reviewed at each EMESRT strategy and planning review meeting.

While EMESRT's role within the industry is well understood and highly regarded by senior OEM leaders and other industry supplier organisations, it has a lower profile in mining companies, including those that are members.

This uneven profile was reconfirmed during ongoing collaboration with the ICMM ICSV program in 2021, where senior OEM manager participants consistently and publicly endorsed EMESRT's successes and ongoing relevance.

This situation reflects EMESRT's underpinning philosophy of focusing on delivering useful outcomes. However, the EAG is working to increase EMESRT's profile and influence with all stakeholders, to increase capacity and support project outcomes.

Relevant stakeholders include research organisations internationally, regulators, industry associations and senior managers in operating mining companies (including EMESRT members).

More information about EMESRT is available on the website - emesrt.org.

EMESRT MEMBERS FOR 2023

TIER 1

Alcoa

AngloAmerican

AngloGoldAshanti

BHP

Glencore

Kiewit

NHG New Hope Group

RioTinto

Teck

Vale

Whitehaven Coal

TIER 2

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