

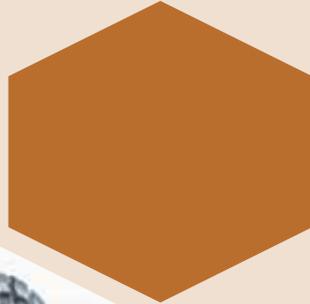
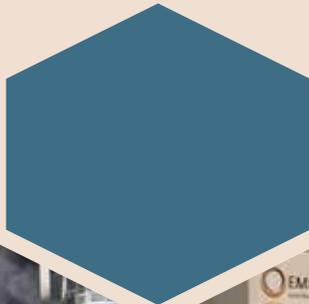


# EMESRT

Earth Moving Equipment Safety Round Table

# 2018

# ANNUAL REPORT



*The industry working together since 2006*

## ACRONYMS

ACARP	The Australian Coal Industry's Research Program
ALARP	As Low As Reasonably Practical
BI	Business Inputs
CAS	Collision Avoidance System
CCM	Critical Control Management
CEO	Chief Executive Officer
CFM	Credible Failure Modes
CFw	Control Framework
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTI	Critical Task Identification
DP	Design Philosophies
EAG	EMESRT Advisory Group
EDEEP	EMESRT Design Evaluation for EME Procurement
EME	Earth Moving Equipment
EMESRT	Earth Moving Equipment Safety Round Table
ICMM	International Council on Mining and Metals
MISHC	Minerals Industry Safety and Health Centre
MOSH	Mining Industry Occupational Safety and Health formed by South African Chamber of Mines and its social partners, government and labour
MSHS	Mine Safety and Health Administration (USA)
NIOSH	The National Institute for Occupational Safety and Health (USA)
OEM	Original Equipment Manufacturer
OMAT	Operability and Maintainability Analysis Technique
PDS	Proximity Detection Systems
QRC	Queensland Resources Council
R&D	Research and Development
ROS	Required Operating States
SAE	Society of Automotive Engineers
SMI	Sustainable Minerals Institute
TBRA	Task Based Risk Assessment
VI	Vehicle Interaction
VIS	Vehicle Interaction Systems

# INTRODUCTION

Established in 2006, the Earth Moving Equipment Safety Round Table (EMESRT) is a global 'safety by design' initiative involving major mining companies that fill the functional expectations gap between customers and equipment designers.

We provide Original Equipment Manufacturers (OEM's) with a customer perspective on operational and maintenance challenges and this supports the development of factory level solutions for the benefit of all parties. A great example is the OEM factory design changes for mobile equipment access/egress and working at heights that have reduced injuries and the need for after-market modifications over the last decade.

EMESRT has become a global mining industry brand. We engage, influence and facilitate health and safety improvements through communities of equipment users, OEM's, researchers and third-party suppliers. In doing this work, our first step is always to develop a deep understanding of issues and problems, before considering solutions.

These operating principles continue to guide our work:

- Design beyond standards
- Balance engineering and behaviour (human factors)
- Recognise the value of task-based design review
- Appreciate that the OEM does its best with the end user involved
- Open genuine 2-way engagement is vital

We maintain a narrow focus, prioritising and working on only a few industry-level opportunities each year to make genuine progress.

In 2018, our most visible industry contribution was the International Council on Mining and Metals - Innovation for Cleaner Safer Vehicles programme that was formally launched in October 2018. This report details our role in its initiation and ongoing input to this important initiative along with our other activities, approach and achievements.



## OUR VISION

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

## OUR 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.

## OUR MEMBERS



## ACKNOWLEDGEMENTS

The EMESRT Advisory Group acknowledges and greatly appreciates the time and effort member company representatives and others put into meetings, webinars and other associated EMESRT activities. We value your generous support and your exceptional experience and expertise.

Thank you also to the OEM's, Proximity Detection System (PDS) suppliers and the general mining community for your support of EMESRT since our formation in 2006. You are all part of our success story.

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# 1. ADVISORY GROUP STATEMENT

This is our report for 2018 and it follows on from our 2017 decision to re-establish an annual report of our activities and projects. The 2017 annual report can be accessed via the EMESRT website - [emesrt.org](http://emesrt.org).

The purpose of EMESRT is to accelerate the development and adoption of leading practice designs for the operation and maintenance of earth moving equipment in mining. We exist to enable the reduction/elimination of injuries and fatalities in our industry, and we do this by:

- Assisting OEM designers and other industry suppliers to develop a deep understanding of customer issues to improve the design of their products
- Identifying common operational and maintenance issues that can be usefully addressed at an industry level, e.g. preventing or mitigating equipment fires
- Coordinating and facilitating industry projects and processes for safe, productive and practical outcomes at operating sites

The approaches that we apply reflect the complexity of the work that we do. For example, we developed the Operability Maintainability Assessment Technique (OMAT) and EMESRT Design Evaluation for Earth Moving Equipment Procurement (EDEEP) processes for reducing or eliminating operating and maintenance hazards through OEM design improvements. These benchmark processes remain in use and continue to assist industry suppliers to design beyond standards.

More recent projects to improve the reliability of vehicle interaction controls have challenged us to develop 'whole of system' approaches that account for multiple level interconnected inputs. These include mine and equipment design, operational practice along with technology solutions improving operator situational awareness and, when necessary, provide active advice and independent interventions. So, while we continue our support of technological projects working with

OEM and third-party PDS suppliers, we developed the new Control Framework (CFw) approach to assist member companies and other industry participants to better understand their specific vehicle interaction circumstances.

The CFw approach supports leaders to make informed decisions, including on what is required for the successful operational implementation and integration of any new controls. We are finding that the approach is particularly useful for understanding those business inputs that are wholly-dependent or part-dependent on the decisions and actions of people.

The CFw approach was first used by EMESRT as the basis for defining functional requirements for vehicle interaction technology review at an industry workshop in early 2018. As explained on page 17 in the Key EMESRT Processes, the CFw approach is aligned with Failure Modes and Effects Analysis, Human Factors and the International Council on Mining and Metals (ICMM) Critical Control Methodology. We anticipate applying this approach to other EMESRT focus topics throughout 2019.

Another notable milestone in 2018 was the Human Factors Design for Diversity Workshop held in May 2018. Industry participants at this workshop reviewed the EMESRT Design Philosophies (DP's) with a focus on highlighting design impediments to establishing a more diverse mining workforce.

As advisory group members, we acknowledge the significant financial input from our respective member companies and their ongoing support for our contributions. On their behalf, we are committed to sustaining and improving safety by design through EMESRT.

In 2018, we achieved these outcomes:

- Supported the expansion of the EMESRT vehicle interaction project into the ICMM programme - Innovation for Cleaner Safer Vehicles (ICSV)
- Maintained vehicle interaction working group membership
- Expanded the number and leadership of EMESRT projects beyond vehicle interaction
- Updated our 2-year planning horizon based on our 5-year strategic plan
- Welcomed new member company representatives to the EAG

To ensure EMESRT remains as relevant as it was at our establishment in 2006, we again reviewed our performance against the 5 success factors first used in 2017:

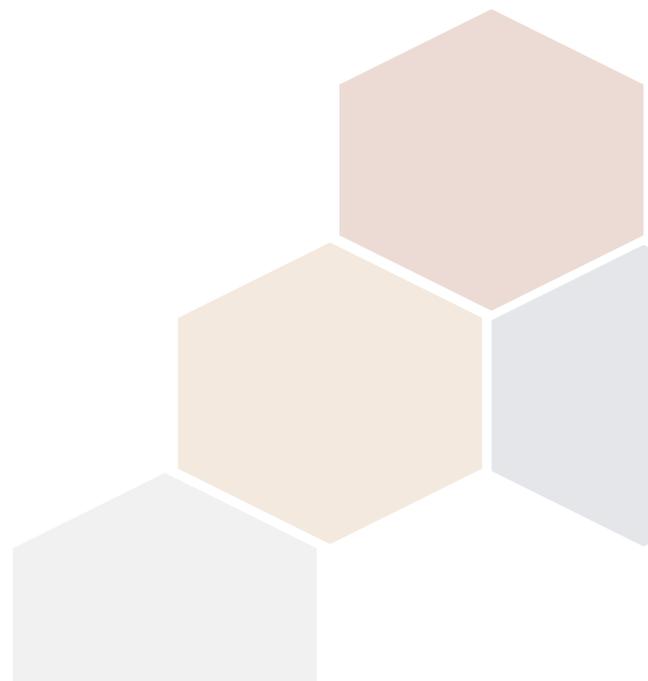
1. Working with an industry-level focus
2. Having a real-world business understanding of financial drivers and leverage that enable investment in design improvements
3. Understanding that innovation is market-driven, not pushed by technology
4. Good governance processes to cover structure, funding, risk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

The report structure is based on these 5 success factors and its intended audience is:

- EMESRT member companies, both specialists and senior leaders
- Earth moving equipment OEM organisations
- Third-party providers, particularly of Vehicle Interaction System (VIS)
- All participants of EMESRT working groups
- Other industry organisations with overlapping missions and memberships, e.g. the ICMM ICSV working groups
- Non-EMESRT member mining companies and contract mining organisations
- All other interested parties

We hope you will find the report informative, useful and enjoyable.

*EMESRT Advisory Group  
June 2019*



## 2. EMESRT SUCCESS FACTORS

To ensure EMESRT remains relevant, we reviewed our performance over the last decade and benchmarked with similar sector leading international organisations. Our 2017 review confirmed these 5 success factors for EMESRT:

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. Good governance processes to cover structure, funding, risk management, renewal and continuity
5. Senior management (decision maker) endorsement

In our 5-year strategic plan, relevant success factors details are included in the context and business case for each EMESRT objective and project.

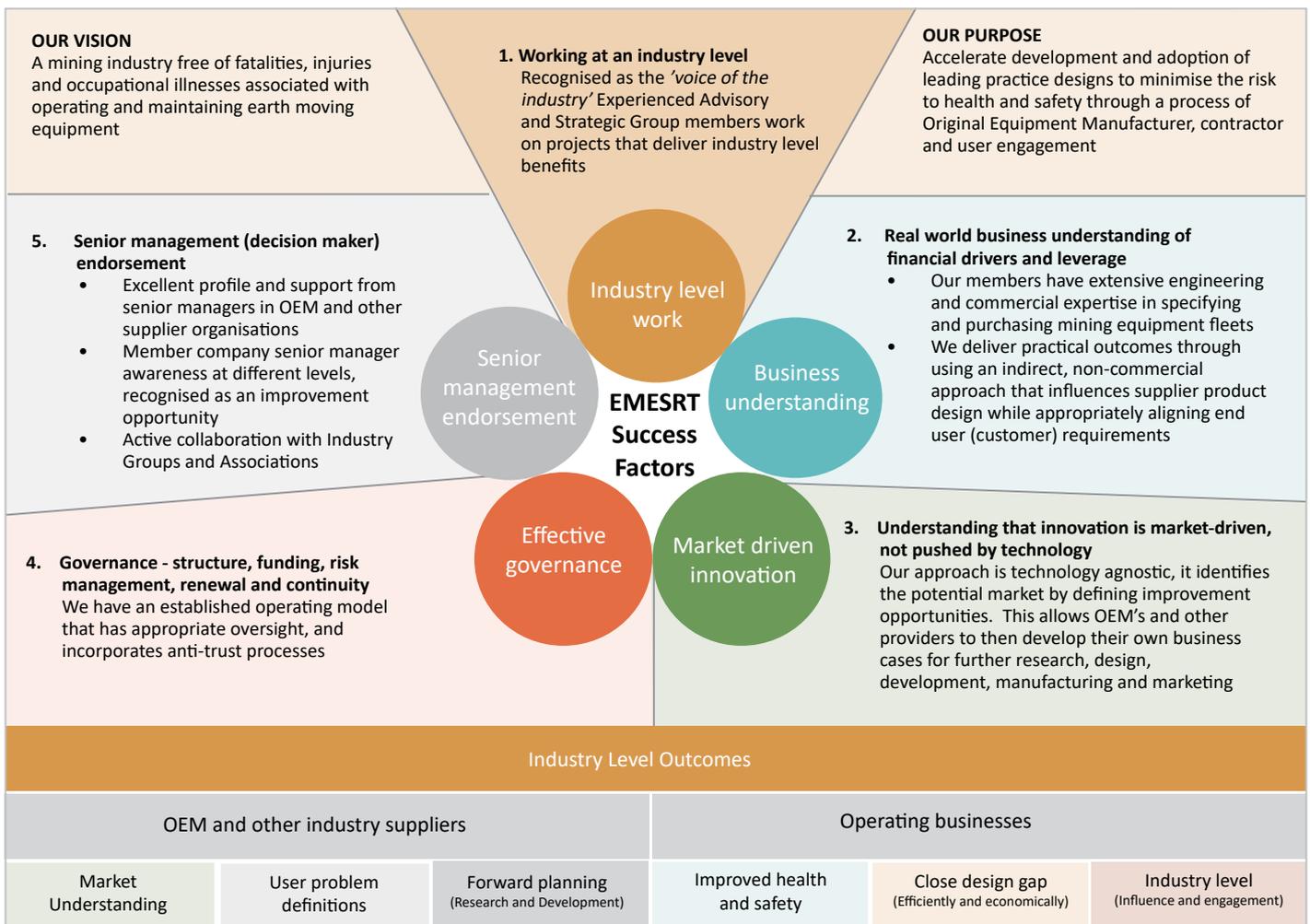


Figure 1: The EMESRT success factors.

### 3. WORKING AT AN INDUSTRY LEVEL

EMESRT member companies represent a significant share of the global annual earth moving equipment spend. Through EMESRT, these companies gain leverage and influence at an industry scale and avoid project duplication when addressing common issues. EMESRT also provides an industry level ‘corporate memory’ with access to resources, experience and expertise.

Key to the EMESRT approach is industry-level engagement with industry OEM’s, to fill the functional knowledge gap between the customers and the equipment designers.

Taking this approach helps OEM’s develop an understanding of operational and maintenance issues from a customer (user) perspective – making rapid advances in equipment design, beyond standards, a possibility. The practical reasons for adopting this approach are:

- Only OEM’s can shrink the design gap that third-party suppliers create businesses to fill
- Working with OEM engineers is important, but Marketing controls the Research and Development (R&D) spend
- There must be a business case before OEM’s will invest in design changes
- Multiple customers stipulating a range of solutions for common OEM design gaps is suboptimal as it creates confusion and prevents progress
- Clearly articulating problems through ‘common industry voice’ creates the OEM business case to invest in improved equipment design
- An ‘approach to defining problems, not solutions,’ supports commitment of R&D funding

This approach has been developed since 2006 and after an initial trust building period, EMESRT has established a mature engagement process between OEM’s and mining customers, while continuing to work with other stakeholders such as third-party PDS suppliers, researchers and industry associations.

For each EMESRT project, the involvement of key industry people is actively sought and our principles, experience and flexible approach guide the required work. Our ongoing success and influence is based on good relationships and a pragmatic industry-level approach.

#### 3.1 OUR MEMBER REACH

Our member company representatives provide both operational and strategic direction while contributing to the delivery of projects. From time-to-time, they also promote EMESRT at industry forums outlining our vision, purpose, approaches, successes and project progress. Presentations from credible industry leaders reconfirms the value of our resource material and methods to a range of audiences. Their advocacy and direct contribution to EMESRT, has over time increased industry design capability for mitigating or eliminating the risks faced by earth moving equipment operators and maintainers.

MEMBER COMPANY	ADVISORY GROUP REPRESENTATIVES
Alcoa	Raymond Wilson
Anglo American	Matthew Clements Gavin White
Barrick	Jonathan Keyes
Glencore	Tony Egan Wayne Clement
Newcrest Mining	Graham Eldridge
Peabody	Megan Kline
Rio Tinto	Mark Geerssen
BHP <sup>1</sup>	Iain Curran

<sup>1</sup>BHP are planning to resume active EMESRT Membership in 2019.

### 3.2 SUMMARY - 2018 MILESTONES AND ACTIVITIES

<b>JANUARY</b> <ul style="list-style-type: none"> <li>Release of draft vehicle interaction functional requirements</li> </ul>	<b>FEBRUARY</b> <ul style="list-style-type: none"> <li>Industry face to face (PDS Validation Framework and VI functional requirements)</li> </ul>	<b>MARCH</b> <ul style="list-style-type: none"> <li>2017 Report released</li> <li>Preparation of 5-Year Strategic Plan</li> <li>ICMM Technology Innovation Workshop</li> </ul>
<b>APRIL</b> <ul style="list-style-type: none"> <li>Release of 5-Year Strategic Plan</li> </ul>	<b>MAY</b> <ul style="list-style-type: none"> <li>Human Factors Design for Diversity - Review of Design Philosophies</li> </ul>	<b>JUNE</b> <ul style="list-style-type: none"> <li>Budget preparation</li> </ul>
<b>JULY</b> <ul style="list-style-type: none"> <li>5-Year Strategic Plan review for 2-year planning cycle</li> </ul>	<b>AUGUST</b> <ul style="list-style-type: none"> <li>Advisory Group Planning session held in Perth</li> <li>ICMM ICVS face to face planning session</li> </ul>	<b>SEPTEMBER</b> <ul style="list-style-type: none"> <li>Update to 2-year project plans</li> </ul>
<b>OCTOBER</b> <ul style="list-style-type: none"> <li>Design Philosophy review commenced</li> <li>EMESRT Case Study presented to ICMM conference on Partnerships and Collaboration for Sustainable Development</li> </ul>	<b>NOVEMBER</b> <ul style="list-style-type: none"> <li>EAG review integrated approaches for vehicle interaction control implementation in Brisbane</li> </ul>	<b>DECEMBER</b> <ul style="list-style-type: none"> <li>Host of ACARP PDS Validation Framework - Tripartite Workshop</li> </ul>

# 4. PROJECT 1 - VEHICLE INTERACTION CONTROL IMPROVEMENT

## 4.1 PROJECT OVERVIEW

Since 2013, EMESRT has led and participated in industry-level initiatives with the common goal of improving the reliability of vehicle interaction controls in mining, including:

- The development of interoperability standards between third-party PDS suppliers and equipment supplied by OEM’s – a common interface protocol allows PDS controls in mixed equipment fleets
- Collaboration with the ICMM Risk Committee, ICMM Collaborative Technology Acceleration Summits and ongoing support during 2018 for the ICMM Innovation for Cleaner Safer Vehicles (ICSV) programme
- Supporting and contributing to the industry review of the ACARP Proximity Detection System Validation Framework Project C26028

The impetus for this work was the rapid development of commercially available Collision Avoidance Systems (CAS). The challenges of integrating and fully realising the potential of new awareness, advisory and intervention technologies with existing design and operational controls is illustrated in Figure 2 below.

The project work applies ‘whole of system’ thinking to improve multi-level, interconnected and dynamic vehicle interaction controls. It is based on Design Philosophy DP-5, ‘Machine Operation and Control and Performance Requirement 5A that:

- Clearly define problems and use
- Use scenarios to confirm understanding
- Develop practical outcomes, e.g. developing performance requirements for the evaluation of Vehicle Interaction technologies

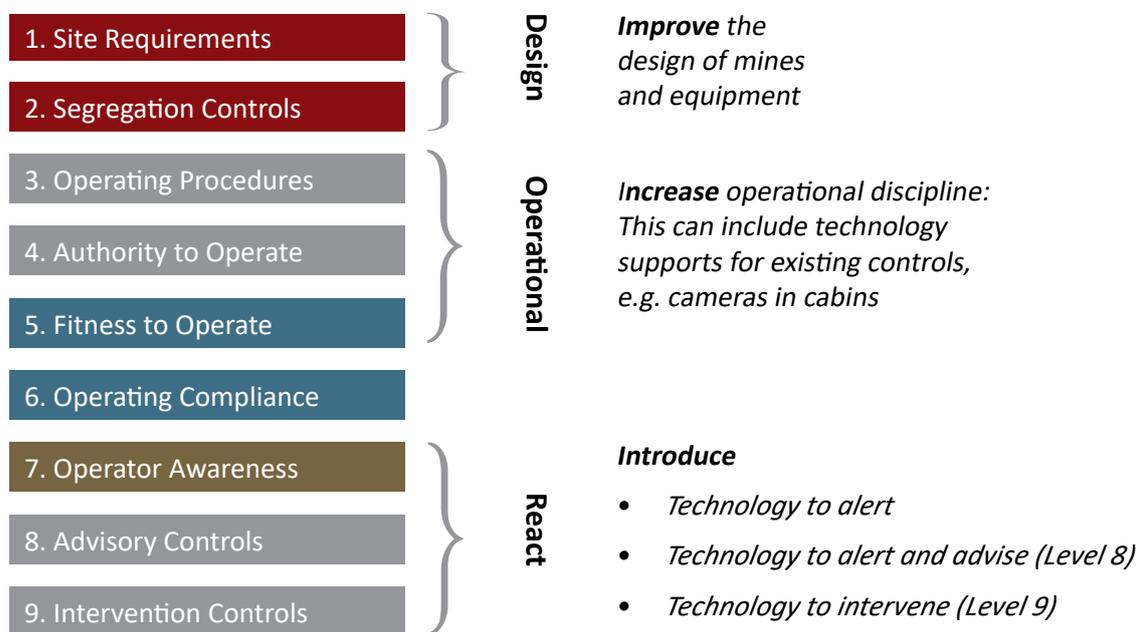


Figure 2: The EMESRT 9 level vehicle interaction control model.

## 4.2 VEHICLE INTERACTION COMMUNITY

The EMESRT approach is to establish working groups of interested parties for each project and then facilitate interaction between participants to deliver project goals and milestones.

The industry level project community for vehicle interaction control improvement project includes over 140 active contacts, representing 34 organisations, some holding both ISO committee and OEM roles.

Community members come from:

- Mining companies
- OEM's
- Third-party PDS suppliers and other stakeholders
- Regulators
- Industry associations, e.g. MOSH from South Africa
- Technical and human factor researchers, e.g. ACARP, CSIRO, Mining3, NIOSH, universities, industry-sponsored organisations
- Expert technical contractors (as required)

During 2018, EMESRT hosted 10 x 2 session webinar teleconferences to brief the global vehicle interaction community on progress and seek their feedback. Our 2-session same agenda approach accommodates for time zones, session discussions are captured in promptly produced minutes that are shared directly with over 140 people and then distributed to the wider EMESRT community. We also use our LinkedIn platform for updates and sharing information.

Participants who are actively contributing to project work are listed below.

PARTICIPANT CATEGORY	ORGANISATION
OEM	1. Atlas Copco 2. Caterpillar 3. Hitachi 4. Joy Global 5. Komatsu 6. Liebherr France 7. Liebherr USA 8. PH Mining 9. Sandvik
Government, industry associations and researchers	1. ACARP 2. CSIRO 3. MOSH 4. MSHA 5. Mining3 6. NIOSH
PDS and other third party equipment, systems and support suppliers	1. Altech Netstar 2. Asirobots 3. Becker Mining 4. Blue Electronics 5. Booyco Engineering 6. GE Mining 7. Guardvant 8. Hexagon (SafeMine) 9. Matrix 10. Minetec 11. Modular 12. MSHA 13. Nerospec 14. PBE Group 15. Schauenburg 16. Sedna 17. Strata
Non EMESRT mining companies including contractors	1. BHP 2. Thiess

### 4.3 INDUSTRY LEVEL PROJECT COLLABORATION - ICMM

In late 2016, senior executives from companies with common membership of the ICMM and EMESRT recognised that both organisations had prioritised industry-level projects to improve collision management and vehicle interaction controls. In early 2017, both groups agreed to explore opportunities for industry-level collaboration and coordination.

Bringing together ICMM's peak industry association status and organisational reach, with EMESRT's global network and design acceleration experience, presents an invaluable opportunity to influence, coordinate and guide vehicle interaction control improvement work at a mining industry level.

The EMESRT contribution is underpinned by these 3 key concepts:

1. New control thinking from the ICMM, Health and Safety Critical Control Management – Good Practice Guide published in April 2015 – specifically the disciplined application of Step 3 - Identify Controls
2. An innovation methodology from EMESRT that seeks to first clearly define the problem and then to confirm understanding based on operational scenarios
3. Innovation thinking that differentiates between operational innovations to improve the performance of existing controls (strongly related to ICMM new control thinking and necessarily driven by the industry) and technology innovations that introduce new controls

EMESRT's position is that there are only 2 options for improving multi-level, interconnected and operationally dynamic control systems such as vehicle interactions in mining, and these are:

1. Improving existing approaches through review, redesign and better application
2. Introducing new controls that address existing weaknesses, either through control replacement or enhancement

The collaboration work advocates a 'not only but also' approach using both improvement options, while also developing a comprehensive and practical understanding of control interdependence. It also confirms this significant collaboration opportunity, considering the aligned missions, experience, membership and strengths of the 2 industry body contributors. Work continued through 2018 exploring what is both possible and required to deliver an accelerated rate of change improvement in the design, operate and react controls for vehicle interaction.

After 2 successful innovation summits and a planning meeting ICMM announced the Innovation for Cleaner Safer Vehicles programme in October 2018 based on a plan to make mining vehicles cleaner and safer through collaboration with leading industry suppliers. The programme has CEO-level support within all participating mining companies and equipment manufacturers.

The announcement noted:

*"After 2 successful innovation summits between ICMM and leading suppliers in the mining industry, a governance model for collaboration has been designed and working groups have been established."*

*"This new collaboration between ICMM and the world's leading mining equipment manufacturers will drive innovation to help us tackle global warming and improve mine safety," said ICMM's CEO Tom Butler.*

*"We hope that this ambitious programme will lead to the development of a new generation of cleaner safer vehicles, and we look forward to working with our new partners."*

#### 4.4 FUNCTIONAL REQUIREMENTS FOR VEHICLE INTERACTION CONTROLS

In January 2018, EMESRT released a consultation draft document listing functional requirements for vehicle interaction controls in surface mining. These were derived from member company work that mapped vehicle interaction relevant business inputs to a vehicle interaction control framework.

These operationally validated functional requirements assist OEM and VIS designers to deliver better technology control products. They also support mine operators to understand the outputs that existing vehicle interaction controls are expected to deliver, and how they can be improved.

The functional requirements for over 120 business inputs that prevent or mitigate credible failure modes from 9 Required Operating States (ROS) were considered in this work. This approach is illustrated in Figure 3 below.

These functional requirements were reviewed in February 2018 as part of the PDS Validation Framework workshop and continue to be used by EMESRT member companies to assess new vehicle interaction technology controls.

#### 4.5 PDS VALIDATION FRAMEWORK INDUSTRY WORKSHOPS

During 2018, EMESRT facilitated an industry introduction and review of the ACARP Proximity Detection System Validation Framework Project through 2 industry workshops with participants from multiple OEM's and PDS suppliers.

The first workshop, held in February, allowed a work in progress review that captured participant feedback both during and after the meeting. It also discussed next steps including using the work as an appendix to support ISO 21815 Collision Warning and Avoidance.

The project continued through 2018 with EMESRT facilitating further Operator, OEM and PDS supplier input when required.

At the well-attended second workshop, held in December, participants:

- Agreed that the Proximity Detection System (PDS) Validation Framework Project had achieved its objective of defining an industry reference methodology

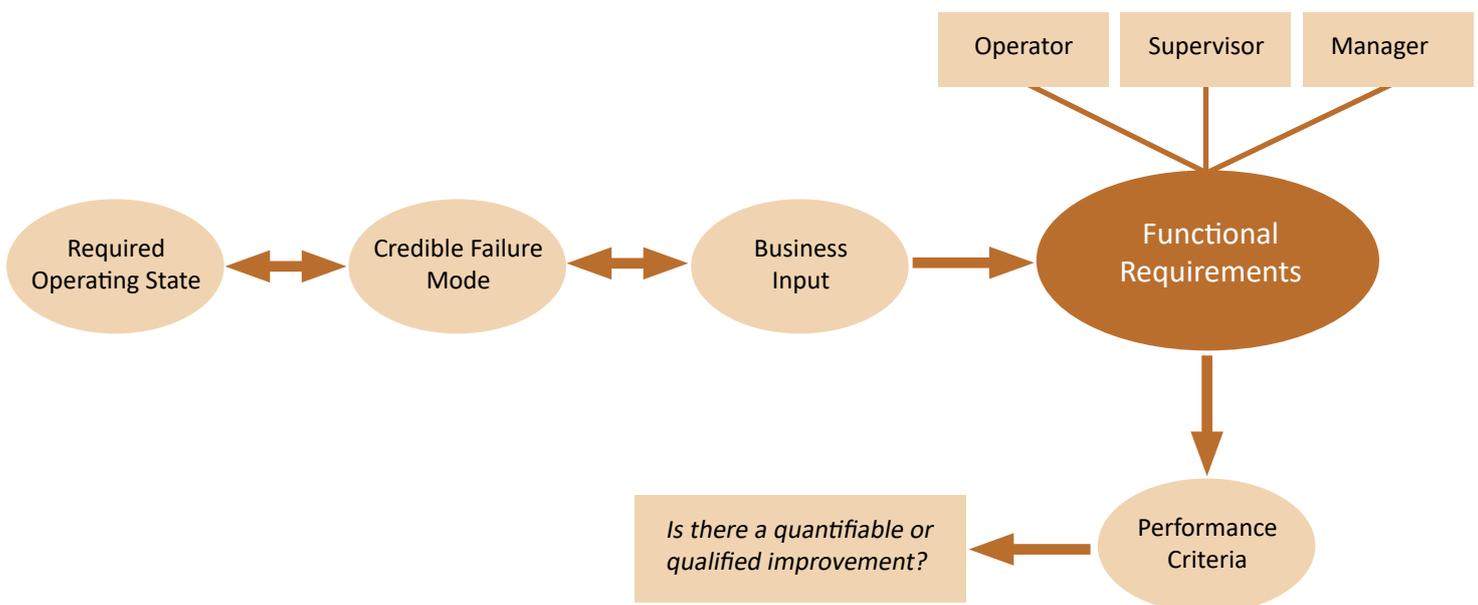


Figure 3: Functional requirements diagram.

- Acknowledged that the PDS Validation Framework Project, does by design, define the minimum set of functionality/performance outcomes for industry, i.e. the minimum set presented at the workshop were applied to demonstrate the methodology and are subject to change
- Confirmed that at a future date, industry representatives will meet to seek agreement on a set of minimum testing scenarios/performance levels and following this test criteria, definition and level setting work, the PDS Validation Framework methodology will be updated
- Included 2 ISO 21815 Collision Warning and Avoidance committee members who confirmed that presentation of the PDS methodology is scheduled for the next ISO meeting in March 2019

The agreed December workshop outcomes:

- ACARP Researchers will discuss alignment/ crossover with the team at the University of Pretoria PDS testing project with a view to collaborate on phase 3 of the project
- The ACARP phase 1 and 2 project report on the methodology will be finalised and published in January 2019
- EMESRT will host a future tripartite Vehicle Interaction Working Group workshop to discuss and define the minimal levels of testing
- This work will consider on what level of performance/ scenarios can become the minimum set to be tested from the factory
- This industry agreed position will then be promoted to the relevant ISO standard working group for inclusion in the future standard
- A working draft list of test criteria for industry definition and level setting will be distributed to a schedule that allows participants and contributors to prepare for the workshop
- The outputs from this important work are expected to confirm an industry level process that will support the rapid development and uptake of improved vehicle interaction controls

#### 4.6 VEHICLE INTERACTION CONTROL IMPROVEMENT PROJECT INTENT

The practical outcomes for the EMESRT vehicle interaction control improvement are:

- Site leaders across our industry have the necessary resources to deeply understand their specific vehicle interaction circumstances and can make informed decisions about the controls that are the most appropriate for their operational situation
- Vehicle interaction controls that can be clearly specified, practically implemented, and then maintained, monitored and routinely verified as part of normal operations
- Adequately proven and available technology becomes available to industry that integrates with and enhances existing control performance while introducing new awareness, advice and intervention controls that are robust and reliable

## 5. PROJECT 2 - HUMAN FACTOR DESIGN FOR DIVERSITY

The general business case for increasing workforce diversity in mining is well established. Improving earth moving equipment design can remove significant anthropometric and other work demand impediments to establishing a more diverse mining workforce. This requires practical on-the-ground improvement of current operational practice and improvements in equipment design, particularly for maintenance tasks.

In May 2018, EMESRT coordinated a Human Factors Design for Diversity workshop. Workshop participants included a range of industry personnel including experienced maintainers and operators of both genders, see participant table below.

The workshop was facilitated by Robin Burgess-Limerick, Professor of Human Factors within the Minerals Industry Safety and Health Centre at The University of Queensland, Australia. Attendees came from members and non-members as well as technical experts in ergonomics/human factors.

The workshop reviewed each EMESRT Design Philosophy considering content and style making these recommendations:

- Include a diversity definition
- Review and update glossary and acronym dictionary and follow a principle to reduce jargon and complexity, e.g. improve acronym management
- Review existing style and compare with other sectors, e.g. aviation, autonomy standards, etc
- Where useful, enhance visual style of DP using illustrations, cartoons, relevant photographs, videos
- Identify opportunities to use new approaches and media to enhance DP's

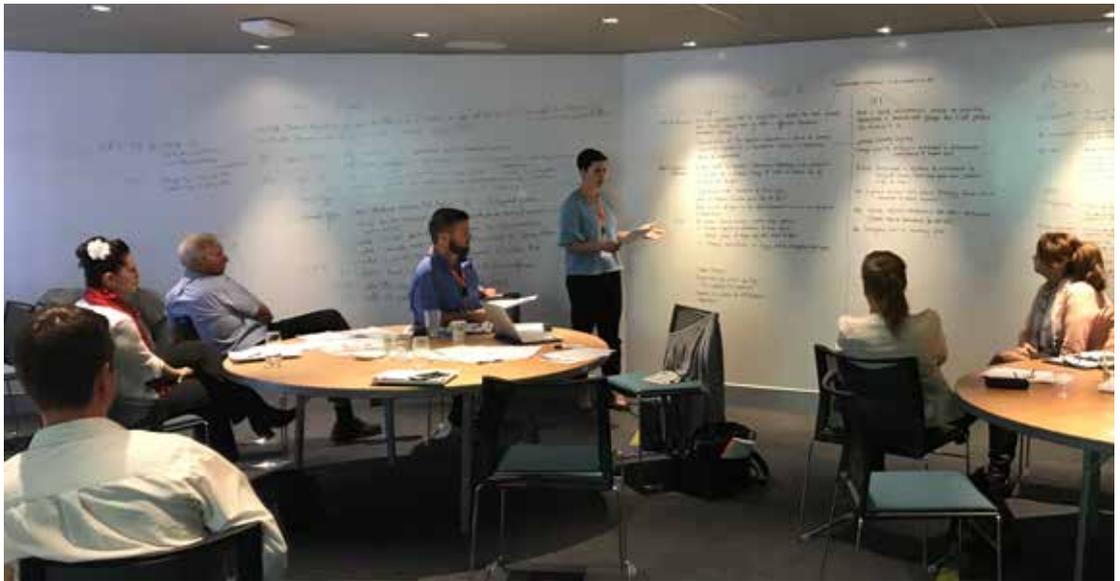
It also noted that diversity goes beyond physical dimensions and includes capacity to interpret and respond to alarms and other advisory controls. Also noted was that while there are opportunities to update the Design Philosophies, they remain fit for purpose.

In October, an experienced technical writer was selected to review and update the design philosophies and incorporate the output from this workshop. These are expected in 2019. As a result of the DP review an ACARP project was supported and will commence in January 2019 (C28034: Mining equipment human factors design for workforce diversity).

The current design of mining equipment unnecessarily restricts the range of potential employees who can safely and comfortably operate and maintain the equipment.

The primary focus of the project is on designs which do not adequately accommodate potential operator and maintainer physical characteristics (static anthropometric variability); and with equipment operation and maintenance tasks which do not sufficiently accommodate potential variability in operator and maintainer strength, flexibility and reach distances (dynamic anthropometry).

ORGANISATION	PARTICIPANT
Alcoa	Ray Wilson Tharcila Peixoto
BHP	Iain Curran Michelle Birt Lauren Glass Rena Berrigan Carolyn Dobson Anthea Coulthard
Glencore	Tony Egan
MISHC, UQ	Robin Burgess-Limerick Danellie Lynas
SMI, UQ	Jim Joy
Peabody	Megan Kline Alan Miskin Jenni Price Chris Hawes Matt Todd
Rio Tinto	Mark Geerssen Liam Wilson
Viva Health	Sara Pazell



## 6. REAL-WORLD BUSINESS UNDERSTANDING

The establishment of EMESRT in 2006 as a formal global mining initiative was driven by the need to fill the design gap between customer and equipment designer functional expectations, to deliver multiple value-adding outcomes including economic benefits.

At the time, mining companies were routinely installing significant after-market modifications, at considerable cost and time, to meet their workplace health and safety obligations.

The real-world business drivers for EMESRT recognise that when OEM's understand the operational and maintenance risks from the customer perspective, and make design changes at the factory level, then all parties benefit.

EMESRT supports this outcome by appropriately aligning equipment end users and ongoing engagement with equipment providers. This includes providing practical industry-tailored tools based on well-established risk, design and human-factor approaches.

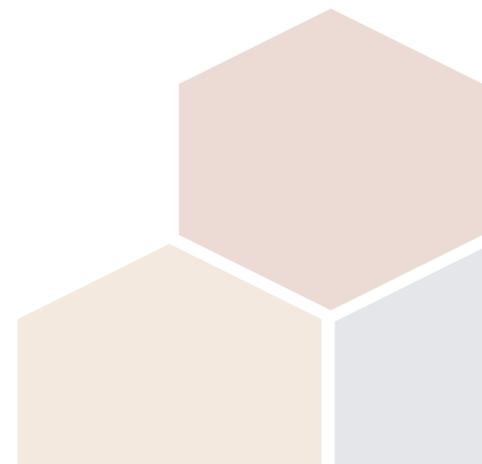
### 6.1 OUR REAL-WORLD ENGAGEMENT APPROACH

Our established engagement approach considers business drivers and interconnections from multiple perspectives.

The real-world value add from EMESRT is in closing the design gap during the purchase of mining equipment. This is achieved through relationships with OEM's and third-party suppliers where EMESRT can influence supplier product design and with appropriate customer alignment through its member companies. This indirect, non-commercial approach helps both sides efficiently manage health and safety specifications when selling and purchasing new mining equipment.

In addition, EMESRT's Advisory Group and Strategic Group members are typically experienced company specialists responsible for purchasing fleets of mining equipment for unambiguous commercial outcomes. Several have also worked for OEM's in the past.

Working at an EMESRT level, members can influence both company alignment and design direction for earth moving equipment suppliers. Their real-world business understanding, and long-term industry relationships provide a level of influence unmatched in the mining industry.



## 7. MARKET DRIVEN

EMESRT works at an industry level to accelerate the development and adoption of design improvements that minimise health and safety risks when operating and maintaining earth moving equipment.

While each member company has its own moral, social, legal and economic drivers to improve health and safety performance, working collectively through EMESRT delivers these benefits:

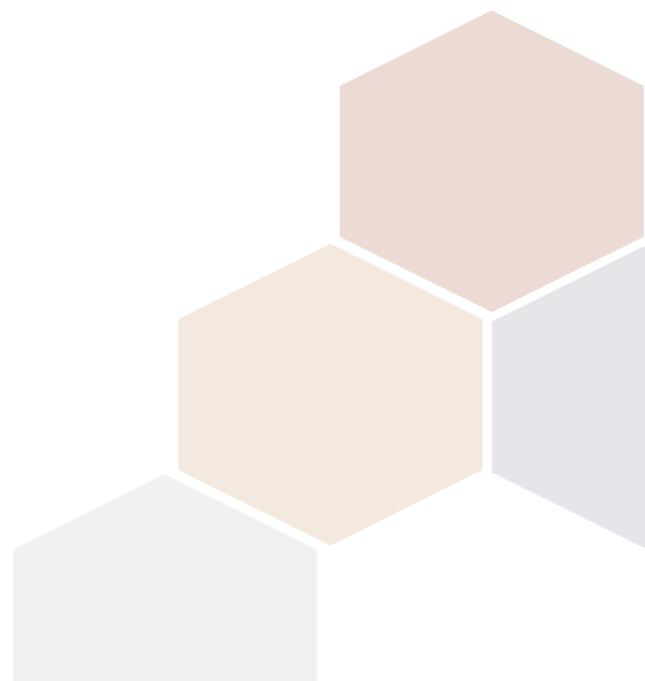
- Leverage and influence at industry scale Input into a common-voice engagement process with OEM and other suppliers based on a proven approach
- Access to resources, experiences and expertise, e.g. international research and EMESRT tools
- Avoid duplication of work on common issues
- Access to an industry level 'corporate memory' Visible company leadership at an industry level
- A neutral way for companies to engage with regulators and standards setters
- Appropriately designed and safer mining equipment

EMESRT members understand that in OEM companies Marketing controls the research and development spend. Therefore, just working through engineers does not achieve the level of R&D required to obtain optimal change in OEM designs.

Collectively, member companies represent a significant percentage of the mining earth moving equipment market and, while this profile is clearly recognised by OEM and third-party suppliers, the EMESRT approach is not about using commercial leverage to deliver what the end-user thinks that they need.

Instead it identifies the potential market through a common industry voice, which defines problems and their associated improvement opportunities that allow OEM's and other providers to then develop their own business case for further research, development, manufacturing and marketing.

The success of this market-confirming approach is illustrated by the rapid uptake of working at heights and equipment access/egress design changes between 2008 and 2012.



## 8. EMESRT - A BRIEF HISTORY

Since early this century, mining companies have jointly discussed the contribution of earth moving equipment design to unwanted events such as incidents, damage and production delays. For 6 global mining companies, these discussions evolved into a formal global initiative in 2006 – the Earth Moving Equipment Safety Round Table (EMESRT).

The initiative was driven by the desire to fill the functional knowledge gap between customers and equipment designers, focusing on new designs where the opportunity for major change was not only possible, but made economic sense.

The first step was to develop and implement a strategy for mining customers to engage with OEM's. This initially involved meeting with 8 surface mining OEM's to discuss perceived problems (design philosophies), understand each other's perspectives and review related risk management approaches.

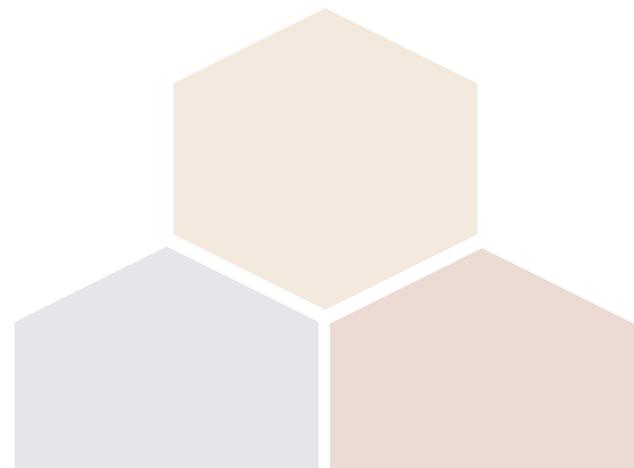
Once this approach was confirmed as adding value then the design challenges were expanded from surface mining equipment used in surface mining, to underground coal and metal mining, along with exploration drilling.

Following requests from several OEM's in 2008, saw the development of OMAT (Operability Maintainability Assessment Technique) that promoted the use of the EMESRT Design Philosophies by engaging users in a structured task-based methodology. Then in 2011, EMESRT took the next step in the OEM engagement process, connecting the issues and methods discussed with a process of evaluating OEM equipment design as part of the mining company procurement process.

EMESRT provides OEM's with an Design Evaluation for Earth Moving Equipment (EME) Procurement process known as EDEEP. This process is described in more detail on page 17 of this report. Essentially, the process enables OEM's to demonstrate that they are designing beyond standards and applying task-based design reviews, as well as clearly linking design features to priority issues.

Since 2006, EMESRT has defined and applied an industry engagement strategy which targets leading mining equipment OEM's, to improve design operability and maintainability. EMESRT has developed a known brand that is recognised across the global mining industry.

Today, EMESRT is recognised for its unique process in initiating and influencing change in designs through engagement with OEM's, and has a global network of mining companies and interested individuals that share the 'one industry, one voice' common goal – a mining industry free of fatalities, injuries and occupational illnesses associated with operating and maintaining earth moving equipment.



## 9. DESIGN PHILOSOPHIES

The EMESRT–OEM engagement process is organised around 8 Design Philosophies. Each presents an aligned viewpoint on objectives, general design outcomes and the potential unwanted events organised by hazard category.

Design Philosophy (DP) content is developed with the aim of providing information to assist OEM's in designing equipment to reduce the risks of potential unwanted events, including foreseeable human error.

The 8 DP categories are:

1. Access and working at heights
2. Tyres and rims
3. Exposure to harmful energies
4. Fire
5. Machine operation and control
6. Health impacting factors
7. Manual tasks
8. Confined spaces and restricted work areas

The EMESRT contribution to improve industry vehicle interaction controls arises from DP-5 Machine Operation and Control.

The DP's motivate the designer to consider machine design from the perspective of the end user, then to pro-actively develop new solutions and innovative ways to reduce the risks of maintaining and operating equipment to As Low As Reasonably Possible (ALARP).

These are the building blocks of EMESRT's Operability and Maintainability Analysis Technique (OMAT) principles.



## 10. KEY EMESRT PROCESSES

With support from the Minerals Industry Safety and Health Centre (MISHC) at The University of Queensland in Brisbane, Australia EMESRT has developed two important processes – Operability and Maintainability Analysis Technique (OMAT) and Design Evaluation for Earth Moving Equipment Procurement (EDEEP).

### 10.1 OPERABILITY AND MAINTAINABILITY ANALYSIS TECHNIQUE

OMAT is a ‘beyond standards’ method which focuses on operational and maintenance tasks for any piece of equipment. It is a task-oriented risk assessment developed to help designers identify and understand the human factor issues associated with operating and maintaining equipment.

Ideally, OMAT should be implemented by OEM’s at the concept stage of equipment design, but it can also be used by mining companies on site to review newly purchased or existing legacy equipment. Ultimately, it aims to eliminate design-related safety issues through strategic hazard identification, risk ranking and control selection.

For designers within OEM’s, the process increases the awareness of ergonomic and human factor risk management issues in designing heavy earth moving equipment for mining companies. This awareness enables them to be proactive in incorporating these ideas into their designs.

### 10.2 DESIGN EVALUATION FOR EARTH MOVING EQUIPMENT PROCUREMENT

The EDEEP process is a suite of tools that includes the OMAT principles. It was developed to help OEM’s demonstrate how they have addressed the problems set out in the DP’s. Meanwhile, using the design controls helps industry members thoroughly evaluate OEM equipment at a residual risk within maintenance and operability tasks.

The EDEEP document is made up of key sections directing the user towards a final document to be supplied to the purchaser for evaluation. These sections include:

- Critical Task Identification information
- DP reference information
- Task Based Risk Assessment document information
- Design feature information from the TBRA

EDEEP enables mining companies considering purchasing equipment to obtain high quality information about equipment safety features in a standardised form. Completing the EDEEP process or equivalent will give OEM’s the information they need to design equipment ‘beyond standards.’

The information kit provides background materials, including the EMESRT DP’s, and a manual describing OMAT for task-based risk assessment, with a spreadsheet for documenting priority tasks, task-based risk assessments and the resulting Safe Design Information. It also includes a more detailed explanation of the process outlined in this report.

EDEEP process documents are available for download at [emesrt.org](http://emesrt.org).

### 10.3 CONTROL FRAMEWORK OVERVIEW

The Control Framework (CFw) approach is an approach that is aligned with Failure Modes and Effects Analysis, Human Factors and definition elements of the ICMM Critical Control Methodology. It considers required business outcomes and then maps in the real-world inputs required to achieve them with a focus on answering:

***‘What has to be in place for work to go right?’***

Applying the CFw approach produces a cross-linked hierarchical structure made up of:

- The few **Required Operating States (ROS)** that deliver business outcomes
- The **Credible Failure Modes** that can compromise the Required Operating States and interrupt the delivery of business outcomes
- The many **Business Inputs** that support the establishment and maintenance of the required operating states through preventing or mitigating the credible failure modes

The approach is particularly useful for understanding those business inputs that are wholly-dependent or part-dependent on the decisions and actions of people. It also provides clarity in ongoing dynamic interactions between multiple required operating states, e.g. safe and productive use of mobile equipment in mines requires operators to maintain clearance, give way, operate at the correct speed, park correctly, respond to alarms, remain alert, etc.

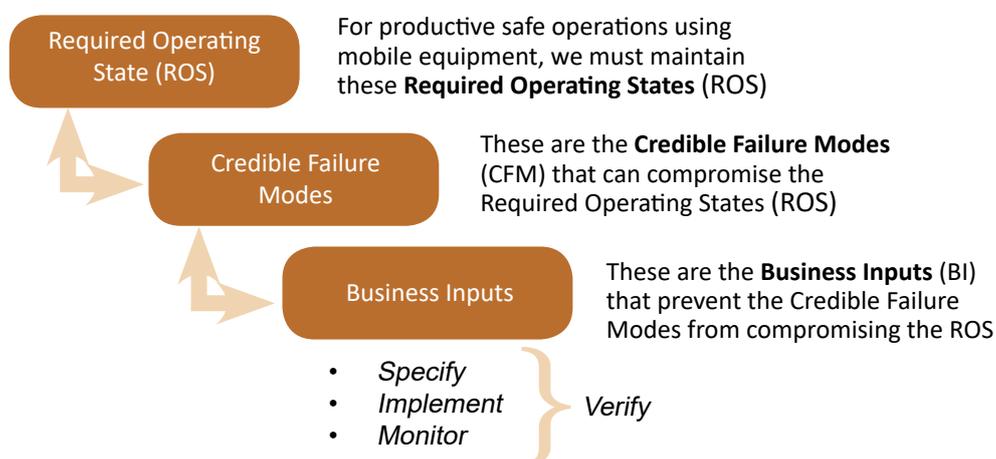
Developing a CFw requires the systematic review and assessment of the robustness and reliability of business inputs, i.e. where the work is done. It follows these steps:

1. Confirm the safe and productive outcomes relevant at an enterprise level, these Required Operating States (ROS) are the basis of CFw organisation, e.g. for Mobile Equipment - Operators Give Way

2. Identify and catalogue the credible failure modes that can compromise each required operating state
3. Based on each credible failure mode, identify the business inputs (control supports) that prevent or mitigate the required operating states being compromised
4. Using multiple information sources, map how each business input is specified, implemented and monitored to prepare a draft CFw Version 1
5. Present CFw Version 1 to knowledgeable and experienced personnel for review, updating and validation to CFw Version 2 (baseline)
6. From the validation workshop, confirm the opportunities for improvement
7. Use the CFw information as a reference when considering further improvement

*“The Control Framework (CFw) approach has been developed by EMESRT as a practical way to apply new control thinking.”*

*EMESRT Advisory Group.*



**Figure 4:** The EMESRT Control Framework hierarchy.

## 11. SENIOR LEADER ENDORSEMENT

During and after the 2017 and 2018 strategy and planning meetings, the effectiveness of the EMESRT approach for engaging with and influencing organisational decision-makers was reviewed.

It was recognised that an extensive positive industry level profile has been established with senior managers at OEM's and third-party equipment providers. It was also recognised that EMESRT connects at appropriate senior management levels with other stakeholders, such as research organisations, regulators and some industry groups.

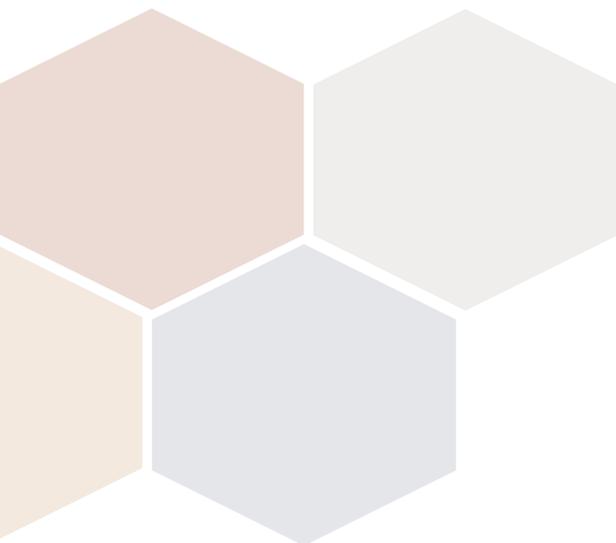
This profile was reconfirmed during collaboration work through the ICMM Technology summits and ICSV programme in 2017-18. Senior OEM manager participants publicly recognised and endorsed EMESRT successes and ongoing relevance.

In contrast, EMESRT has a lower profile with senior managers in member organisations, and peak industry groups and associations. This was identified as an area for improvement, so momentum is increased to tackle more complex and expensive R&D.

Actions to address this significant success factor gap are now part of the rolling 2-year EMESRT Plan, and include:

- Applying the experience and skills of new and existing EMESRT Advisory Group (EAG) members to ensure that EMESRT materials and approaches are suitable for their intended audience
- Preparing a stakeholder management objective as part of the EMESRT 5-year plan in early 2018
- Restyling EMESRT Update Information for adaption and use by member companies
- Updating EMESRT's reporting style and format to work for a broader audience range, e.g. this report
- Ongoing participation with the ICMM industry peak body level, in both project work and in an advisory capacity, such as on governance, process and structure for project management

The intended outcomes from this work are an effective, professional, consistent stakeholder management approach that anticipates and meets EMESRT requirements and delivers successful and ongoing engagement with member company senior managers.



## 12. GOVERNANCE

### 12.1 STRUCTURE

EMESRT is a safety by design organisation that facilitates equipment design outcomes at an industry level and its work program is based around coordinating the delivery of specific projects. Advisory group members, who are senior managers in their respective organisations, make contributions based on their availability, experience and expertise.

EMESRT membership is limited to mining companies with contracted secretariat support provided by Mining3, a leading research organisation with global mining industry members. Further consultant support is sourced as required. Although membership is limited to mining companies, EMESRT recognises that constant/broad consultation with other stakeholders is vital to its success.

### 12.2 FUNDING

EMESRT member companies pay an annual membership fee and, based on project load and planning, make adequate funds available as required.

Many projects involve coordinating and connecting work already in progress by other sources, e.g. facilitating industry workshops in 2018 to support the PDS Validation Project funded by ACARP, university research, and other technical R&D by research organisations and sponsoring member participation in ICMW workshops.

### 12.3 RISK MANAGEMENT

EMESRT members are aware of managing anti-trust issues and processes have been in place since OEM engagement work commenced.

**In scope**, EMESRT will:

- Focus on design of earth moving equipment in surface and underground mines
- Provide aligned design expectations based on risk
- Involve interested companies in the industry
- Share openly with all interested OEM's
- Listen, consider and value OEM contributions

- Provide information on leading practice to OEM's
- Share leading practice to assist 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 design
- Share OEM confidential information with other OEM's
- Impose adoption of solutions on member company sites
- Risk management for EMESRT projects and important communications includes legal reviews to avoid liability and anti-trust issues

### 12.4 CONTINUITY AND RENEWAL

One of EMESRT's significant strengths is the continuity of its member organisation representatives. A core group has been involved since EMESRT began and have made significant contributions to developing the reach and profile of the organisation, delivering projects and method development.

Beyond this, each applies their professional skills, supported by a deep understanding of EMESRT's purpose, design philosophies and success factors, to coordinate efficient industry-level responses.

Each objective in the EMESRT's 2–5 year working plan considers organisational success beyond the retirement of the founder cohort. From the strategic plan - Objective 3: Formalise key methodologies is intended to capture of the knowledge and experience of long-term EAG members through documenting the evolution of methods and project management approaches.

In addition, an ongoing renewal of company representatives is also being managed, which includes having multiple representatives from some member companies. For EMESRT, an increase in diversity of experience and skills is invaluable, as it assists us in dealing with opportunities identified during 2017–18 planning.

## 12.5 STRATEGY AND PLANNING

In March 2018, we released a new 5-Year Strategic Plan to reconfirm the long-term vision and purpose of EMESRT. It sets direction and goals for the next 5 years and details the 12 - 24 month work plans required for their delivery.

The planning work considered:

- Existing project complexity
- Potential future projects to address industry level issues
- Opportunities to raise organisational profile, improve stakeholder management and promote further productive collaborations
- A need to update evolving methodologies and project management processes

It was prepared by the member company representatives who make up the EMESRT Advisory Group and endorsed by the senior company managers who provide oversight as the EMESRT Strategic Group.

The Strategic Plan is based around 4 objectives and 3 projects.

These 4 objectives form the core of the non-project EMESRT workplan for the next 12 – 24 months.

**Objective 1: Profile** - lift profile, maintain and increase membership.

**Objective 2: Design Philosophies** - review and refresh foundation EMESRT Design Philosophies.

**Objective 3: Formalise key methods** - document the evolution of EMESRT methods and project management approaches.

**Objective 4: Stakeholder management** - confirm a formal stakeholder approach.

Each objective is developed using a 7-element planning process that describes:

1. Context and industry business case
2. Current state
3. Target state
4. Timeline
5. Action planning
6. Required resources
7. Implementation approach

The complex project work for the next 12 – 24 months is based on:

**Project 1: Vehicle Interaction Control Improvement** - An industry project to develop and implement an innovation resource and methodology for the systematic and practical improvement of vehicle interaction controls in mining.

**Project 2: Human Factor Design for Diversity (2018)** - an industry project to define design requirements that support gender neutral mining plant operation and maintenance.

Improving earth moving equipment design can remove significant anthropometric impediments for establishing a more diverse (gender neutral) mining workforce. These same design improvements can reduce the possibility of cumulative injuries for current operators and maintainers.

Further details on Project 1 and Project 2 is provided in earlier sections of this report .

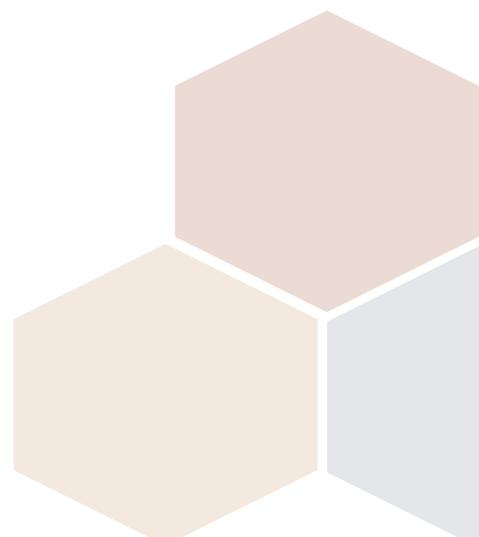
**Project 3: Develop and Apply the Control Framework Approach to Tyre Management and Equipment Fires.**

## 13. 2-YEAR PLAN 2018 - 2020

Over 3 days, 22-24 August 2018, the EMESRT Advisory Group (EAG) met in Brisbane, Australia to review the EMESRT strategy, objectives and current projects and update the 2-year plan.

These concepts were also discussed and developed:

- Over the last decade, EMESRT has developed and applied industry benchmark approaches that assist OEM designers to improve equipment design to meet its purpose 'to advance the design of the equipment to improve safe operability and maintainability beyond Standards'
- This continuing contribution is acknowledged by OEM's and recognised at an industry level, e.g. through the ICMM Technology Collaboration working group
- While delivering Project 1 - Vehicle Interaction, over the last 5 years the EAG has developed processes to assist OEM's and third-party PDS suppliers and these are also partly relevant to the operational practice of member companies and other mining industry participants
- Output from these processes relevant to both designers and operators includes:
  - Performance Requirement PR-5A has developed to augment interpretation of Design Philosophy 5, Machine Operation and Controls
  - The adaptation and widespread use of the 9-level vehicle control model
  - The release of draft vehicle interaction functional requirements in early 2018
  - Collaborative work with the ICMM to establish resources for the systematic improvement of vehicle interaction controls from 2017
- This work has been informed by the real-world application of 'new control' thinking within member companies (as detailed in ACARP research and the ICMM Guide on Critical Control Methodology)
- By the end of September 2018, the EAG has committed to support the development of a 'Control Framework' approach which is intended to provide useful control improvement insights for both mining equipment designers and operators as part of Objective 3 - Formalise key methods



## 14. 2018 SUMMARY PLAN

### Objective 1 - Profile and Objective 4 - Stakeholder Management (Consolidated in 2018 Planning)

STRATEGY LINK	BACKGROUND	2-YEAR PLAN
<b>Plan, strategy and report</b>	<p>Most Objective 1 Profile milestones were successfully delivered in 2018 including:</p> <ul style="list-style-type: none"> <li>Industry acknowledgement of EMESRT influence and methodologies during ICMM OEM collaboration workshop</li> <li>Ongoing collaboration with the ICMM</li> <li>The release of a 2017 Project Report and 5-Year EMESRT Strategy</li> </ul> <p>The remainder are now being re-incorporated into in Objective 4 Stakeholder Management.</p>	<p>Prepare a 2018 Project Report.</p> <p>Update 5-Year EMESRT Strategy to combine Objective 1 and Objective 4.</p> <p>Update member briefing packs.</p> <p>Review and update resources for use during industry events and briefing of industry groups and key stakeholders, e.g. regulators, professional associations (mine managers and technical specialists).</p> <p>Review and update the graphic overview (potential navigation aid) of how all the EMESRT parts and process contribute to delivering its mission and meeting its purpose, considering collaboration and key methodologies.</p>
<b>Objective 4</b>	<p>Review and update the at-draft stakeholder management plan (delayed from 2017 due to EAG member turnover).</p>	<p>Review draft stakeholder management plan:</p> <ul style="list-style-type: none"> <li>Confirm that it adequately captures current good practise</li> <li>Confirm current stakeholder groups, e.g. OEM, PDS supplies, regulators, researchers, etc</li> <li>Include member company senior managers as a special stakeholder group</li> <li>Include industry associations, e.g. the Minerals Council fo Australia, South African Chamber of Mines and ICMM as a specific stakeholder group</li> </ul>
<b>Objective 4</b>	<p>Develop EMESRT stakeholder management resources and capability.</p> <p>Improve in-company marketing, message, and demonstrating value.</p> <p>Currently supporting OEM's is emphasised - how do we reconnect with our parent companies (industry).</p> <p>Cross reference to the Control Framework Approach.</p>	<p>Provide resources that are suitable for member companies: AngloAmerican case study example of community of practice and has increased EMESRT profile</p> <ul style="list-style-type: none"> <li>Continually update EMESRT support material, e.g. Working at heights and access/egress case study</li> <li>Review the practicality of establishing a common sharing drive/directory</li> <li>Prepare case studies and other information covering EMESRT level of influence and delivery on the ground</li> <li>Re-establish the EMESRT Strategy Group</li> </ul>

**Objective 2 - Design Philosophies** is consolidated with **Project 2 - Human Factors Design for Diversity**

STRATEGY LINK	BACKGROUND	2-YEAR PLAN
<p><b>HFDD May industry workshop to support Project 2</b></p> <p><b>Objective 2 DP - Review</b></p>	<p><b>Project 2 - HFDD</b></p> <p>The general business case for increasing workforce diversity in mining is well established. Improving earth moving equipment design can remove significant work demand impediments to establishing a more diverse mining workforce.</p> <p>This requires practical on-the-ground improvement of current operational practice and improvements in equipment design, particularly for maintenance tasks.</p> <p><b>Objective 2 - Design Philosophies</b></p> <p>Design Philosophies are a core EMESRT industry level offering, it is essential that they remain, relevant, up-to-date and usable. The DP's motivate the designer to consider machine design from the perspective of the end user, then to pro-actively develop new solutions and innovative ways to reduce the risks of maintaining and operating equipment.</p> <p>They were developed over a decade ago and it is appropriate to seek user feedback and the review and refresh EMESRT Design Philosophy content and style.</p>	<p>Combine Project 2 - HFDD and Objective 2 - Design Philosophies to reflect and incorporate:</p> <ul style="list-style-type: none"> <li>• Output from the May HFDD workshop</li> <li>• EAG review of workshop output</li> <li>• Opportunities developed and discussed at the August EAG Planning Meeting</li> </ul> <p>Select an experienced technical writer to concurrently work on Project 2 - HFDD and Objective 2 - Design Philosophy review and complete the following:</p> <ul style="list-style-type: none"> <li>• Edit and adopt draft diversity definition from the HFDD May workshop</li> <li>• Follow a principle to reduce jargon and complexity e.g. improve acronym management in DP's</li> <li>• Review exiting DP style and compare 'with other sectors e.g. aviation, autonomy standards, etc</li> <li>• Where useful enhance visual style of DP using illustrations, cartoon, relevant photographs, videos</li> <li>• Identify opportunities to use new approaches and media to enhance DP's</li> </ul>
<p><b>Objective 4 Stakeholder Management Plan</b></p>	<p><b>Design Philosophy Stakeholder Management Plan</b></p> <p>Engage with and update stakeholders for both Project 2 - HFDD and Objective 2 - Design Philosophies.</p> <p>Building from the HFDD review, complete an external review of all EMESRT Design Philosophies.</p>	<p>Confirm stakeholders for Design Philosophies and HFDD work noting that diversity goes beyond physical dimensions and includes capacity to interpret and respond to alarms and other advisory controls and has been considered in all DP's:</p> <ul style="list-style-type: none"> <li>• Define stakeholders and decide how and when they will be approached</li> <li>• Define and consult with stakeholders for feedback when revised DP's at final draft</li> <li>• Identify where extra information may be developed to better design a DP, e.g. PR5A or additional function requirements</li> <li>• Confirm any cross overs to the developing of the Control Framework approach</li> </ul>
<p><b>Project 2</b></p> <p><b>Objective 2, Objective 4, Objective 3</b></p>	<p><b>OEM Road Show</b></p> <p>Develop content, interact with OEM at senior management level.</p> <p>Present outputs from the combined Diversity and Design Philosophy work.</p> <p>Aim for OEM factory-based personnel rather than dealer representatives.</p> <p>Use examples to define problems and frame opportunities.</p> <p>Design for 2-way engagement as for previous experience with EDEEP.</p>	<p>Develop OEM workshop intent, agenda, content, and approach:</p> <ul style="list-style-type: none"> <li>• Identify options for connecting with as many people in different locations as possible</li> <li>• Highlight how the Project - 1 HFDD (diversity) is included as part of the review of all Design Philosophies</li> <li>• Prepare a pipeline/horizon strategy confirming any plans to develop further information that support DP's and how it will include OEM input</li> <li>• Benchmark and consult with OEM's to determine their position asking a series of questions such as "how are you managing diversity in theory and practice and can we learn from your manufacturing experience and take it into equipment maintenance"?</li> </ul>

## Objective 1 - Formalise key methodologies

STRATEGY LINK	BACKGROUND	2-YEAR PLAN
<p><b>EDEEP</b></p>	<p><b>From Project 2 - HFDD Workshop</b></p> <p>EDEEP - Design Evaluation for Earth Moving Equipment Procurement.</p> <p>Ensure consequences for priority tasks clearly include health and diversity.</p> <p>Add the need to include diversity reps in the EDEEP analysis methods.</p> <p>Look at EDEEP to include diversity - especially 20 PUE prompts for Task Prioritisation.</p>	<p>Review EDEEP support materials, e.g. facilitator's guide:</p> <ul style="list-style-type: none"> <li>• Ensure health outcomes are included in the functional requirements</li> <li>• Make diversity explicit as part of the process noting that it is already implied</li> <li>• Incorporate knowledge and experience of long term EAG members</li> <li>• Where appropriate align with new-control thinking</li> </ul>
<p><b>OMAT</b></p>	<p><b>From Project 2 - HFDD Workshop</b></p> <p>OMAT - Operability and Maintainability Analysis Technique.</p> <p>OMAT is the tool for doing legacy reviews, the process builds from existing knowledge as a starting point.</p> <p>Member companies who undertake OMAT's might choose to make them available through EMESRT.</p>	<p>Carry out a review of OMAT:</p> <ul style="list-style-type: none"> <li>• Reconnect with MISHC at the University of Queensland to utilise their resources</li> <li>• Review OMAT facilitator guide and content including familiarisation resources for workshop participants</li> <li>• Check with knowledgeable and experienced people about how support resources are best updated e.g. using video analysis</li> <li>• Incorporate knowledge and experience of long term EAG members</li> <li>• Where appropriate align with new-control thinking, e.g. the EMESRT CFw approach</li> </ul>
<p><b>Control Framework approach - confirm methodology</b></p>	<p>During discussions and planning work the contribution of EMESRT and its processes to assist member companies resolve design legacy issues was explored.</p> <p>The relevance of the in-company use of the OMAT process was confirmed as being a relevant EMESRT resource.</p> <p>Also discussed was the in-company approach that provided the material that was developed into the draft EMESRT vehicle interaction functional requirements.</p> <p>The EAG recognised that further developing this methodology through applying it to review long-term industry issues such as tyre and rims management and vehicle fires should be part of the 2-year plan.</p> <p>Once proven, the approach might be applied to prepare an industry level problem definition starting point for multiple other design issues that can be partly or fully resolved by operators.</p>	<p>Provide resources that are suitable for member companies.</p> <p>Develop and apply the Control Framework approach for:</p> <ul style="list-style-type: none"> <li>• Tyre handling, mounting and wheel installation still requires intensive manual handling and involves high risk actions at certain stages</li> <li>• Most controls are dependent on people</li> <li>• Define required operating states, credible failure modes and map business inputs add value</li> </ul> <p>Use this information to review current practices for tyre management:</p> <ul style="list-style-type: none"> <li>• Component design</li> <li>• Work methods - how wheels are assembled, disassembled, shifted, mounted, etc</li> <li>• Consider how technology might be applied to reduce manual handling and high-hazard task</li> </ul>
<p><b>Control Framework approach - review multiple topic areas</b></p>	<p>Ongoing work program - once the control framework approaches are proven then apply for other EAG recognised focus topics such as:</p> <ul style="list-style-type: none"> <li>• Equipment fires</li> <li>• Live work - inspection and programming</li> <li>• Dust management and other health issues</li> <li>• Cab screen layout</li> </ul>	<p>Confirm Control Framework methodology for equipment fires and tyres.</p> <p>Apply and link industry work to date to prepare a relevant control framework:</p> <ul style="list-style-type: none"> <li>• Review the Minerals Council of Australia (MCA) Tyre Project work 2016</li> <li>• ACARP project(s)</li> <li>• Other information sources such as legislation and code of practice</li> </ul> <p>Schedule an EAG progress review in October. Confirm priority to applying the same approach for other issues based on industry fatality records including adverse health outcomes.</p>

## Project 1 - Vehicle Interaction

STRATEGY LINK	BACKGROUND	2-YEAR PLAN
<p><b>Progress to plan and next steps</b></p>	<p>General discussion on Project 1 - Noting progress plan since October 2017 has delivered each required milestone and adjusted to deliver as required</p> <p>It was noted that current work covers:</p> <ul style="list-style-type: none"> <li>Continuing engagement with the ICMM based on 2017 EMESRT Proposal</li> <li>Supporting the direction of the ICMM Technology OEM Collaboration Vehicle Interaction Working Group</li> <li>Working with the ICMM to develop a vehicle interaction control improvement information hub</li> <li>Ongoing support for ISO 21815 PDS interface protocol</li> <li>Promoting a recent ACARP project for PDS validation to ISO as key supporting process</li> <li>Release of the draft EMESRT vehicle interaction control functional requirements in early 2018</li> </ul>	<p>Ongoing EAG vehicle interaction work:</p> <ul style="list-style-type: none"> <li>EMESRT Advisory Group members continue to support company colleagues working on ICMM projects</li> <li>Extend ACARP/ISO PDS test methodology to include underground</li> <li>Adapt approaches used to confirm vehicle interaction functional requirements to develop a control framework approach (see Objective 3 – Methodologies)</li> </ul> <p>For further discussion and development through the next 24 months:</p> <ul style="list-style-type: none"> <li>Applications of technology assistance controls for control levels 5 – 8 and relationships between existing and new controls (based on case studies)</li> <li>Consider human factors aspects arising from autonomy operations (i.e. the widespread implementation of level 9 controls)</li> <li>Note that automation is a solution, it removes some people, but people are still required e.g. maintenance</li> <li>Consider developing failure modes for automation using the still developing control framework approach</li> <li>Learnings from major projects around automation</li> <li>What are the real-world solutions e.g. for mixed fleets etc</li> <li>EMESRT to interpret industry knowledge and technical support e.g. ISO standard and prepare summary user information</li> </ul> <p>Update 5-Year Strategy and 2-year plan to capture developments.</p>
<p><b>ACARP PDS Validation Framework</b></p>	<p>The ACARP C26028 PDS Validation Framework project is directly relevant to EMESRT Vehicle Interaction work. It is proposed that it becomes an ISO reference for PDS validation.</p>	<p>Coordinate tripartite workshop in Brisbane in 2018 to:</p> <ul style="list-style-type: none"> <li>Agree a set of minimum testing scenarios/ performance levels</li> <li>Acceptable base for products to be promoted as having a minimum set of functionality/ performance</li> </ul>
<p><b>Vehicle Interaction Control Improvement Portal</b></p>	<p>Based on collaboration with EMESRT, the ICMM Risk Committee is developing an industry level innovation resource and methodology for the systematic and practical improvement of vehicle interaction controls in mining.</p> <p>The associated work for this resource is being developed on a cloud-based platform that will connect information and know how based on the Control Framework approach.</p>	<p>Ongoing ICMM project progress updates to EAG.</p> <p>Use the Risk Mentor Platform to prepare a control framework for tyres.</p> <p>Present the information to the EAG for review (version 1 in September).</p> <p>EAG members to review outputs and progress with ICMM Vehicle Interaction Controls (October).</p> <p>EAG decisions on further use of Risk Mentor Platform to develop other Control Framework information (October).</p>

## APPENDIX A - PERFORMANCE REVIEW

### EMESRT 2018 SUCCESS FACTORS PERFORMANCE SNAPSHOT

SUCCESS FACTORS	CARBON TRUST BENCHMARKS <sup>1</sup>	EMESRT - THE ORGANISATION
<b>1. Working at an industry level</b>	Joint industry collaborations focus on sector-wide benefits, identified through rigorous, objective, fact-based analysis and extensive engagement.	Strategy and project direction informed by experience of company representatives with internal multi-site responsibilities and who often represent their organisations in other industry forums e.g. ICMM and regional mining associations.
<b>2. Real world business understanding of financial drivers and leverage</b>	Meaningful financial leverage secured for joint industry collaborations to enable greater overall impact and ensure industry commitment.	Member backgrounds - mining company engineering and commercial expertise, e.g. in purchasing mining equipment fleets.
<b>3. Understanding that innovation is market-driven, not pushed by technology</b>	Joint industry collaborations designed to catalyse markets by overcoming commercial barriers rather than championing individual technologies or solution.	Understanding business drivers (the market) from all perspectives is the basis of the organisation. A relevant current example is the market enabling work to prepare an ISO interface standard between mining equipment and PDS technology.
<b>4. Governance – structure, funding, risk management, renewal and continuity</b>	Governance structures for joint industry collaborations tailored to specific initiatives but all cover key elements including intellectual property (sharing and protection) and decision-making rights.	Established operating model with appropriate oversight. Anti-trust processes are in place. Committed to documenting and formalising very effective semi-formal process in 2018.
<b>5. Senior management (decision maker) endorsement</b>	Industry partners expected to demonstrate commitment to initiatives through senior management sponsorship.	Member company awareness is at different levels with a low profile in many. This also extends to non-specialist industry groups and associations. This has been identified as an area for improvement in current plan.

EXTERNAL EMESRT PROFILE e.g. WITH OEM's AND PDS SUPPLIERS	EMESRT PROJECT WORK - VEHICLE INTERACTION PROJECT <sup>2</sup>
EMESRT recognised and acknowledged as delivering sector-wide benefits e.g. current diversity of vehicle interaction community. This 'voice of the industry' status is founded on ongoing industry wide engagement since 2006.	Evidenced by company membership and project collaboration with the ICMM since 2016.
The real-world value add is closing the specification gap when purchasing mining equipment. This indirect, non-commercial approach is achieved through influencing supplier product design and appropriate mine site customer alignment.	The project is based on an understanding that industry level coordination work is required before the business case can be made to deploy vehicle interaction controls at a mine site level. This includes developing assessments to ensure that new technology is fit-for-purpose.
The well-accepted EMESRT approach is technology agnostic identifies the potential market by defining improvement opportunities, allowing OEM's and other providers to then develop their own business case for further research, development, manufacturing and marketing.	Project work has developed a deep understanding of what is necessary to improve multi-level, interconnected and operationally dynamic vehicle interaction control systems; the first is improving existing approaches through review, redesign and better application, and the second is through introducing new technology controls that address existing weaknesses either through control replacement or compensation.
For over 13 years EMESRT has been recognised at the credible and trusted voice of the industry. This positive position is underpinned by long term relationships between EMESRT member company representatives and OEM organisations.	Direct project oversight and contributions from EAG members. Project milestones are being achieved.
OEM senior management are well aware and supportive of ongoing engagement with EMESRT.	The project is supported by all member companies and in 2017 an ICMM collaboration was proposed. EMESRT representatives attended and presented at the ICMM Technology conferences on EMESRT processes and successes. Commencing in 2018 EMESRT continues to support the ICMM Programme for Cleaner Safer Vehicles (ICSV).

<sup>1</sup>The Carbon Trust is an independent, mission-driven, expert partner of leading organisations around the world, helping them contribute to and benefit from a more sustainable future (find out more: [www.carbontrust.com](http://www.carbontrust.com))

<sup>2</sup>EMESRT's Vehicle Interaction Project commenced in 2013 and is ongoing

# APPENDIX B - PROGRESS TO 2017 PLAN - SCORECARD

## EMESRT 2018 SUCCESS FACTORS PERFORMANCE SNAPSHOT

1. EMESRT ORGANISATIONAL OBJECTIVES - MAINTAINING AND ENHANCING KEY PROCESSES (2018 PROGRESS TO PLAN)			
REFERENCE	DESCRIPTION	NEXT STEPS	STATUS AT 31 DECEMBER 2018
Objective 1	Update existing material, outline EMESRT member company benefits for the short to medium term, as well as making a contribution to industry including long-term strategy covering: <ul style="list-style-type: none"> <li>• EMESRT history and notable milestones</li> <li>• Monthly industry forum on vehicle interaction control progress</li> <li>• Stakeholder identification and management plans, e.g. interface with researchers, regulators, standards setting bodies</li> </ul>	<b>Short term:</b> Refresh and re-issue new and existing member support material by Q1 2018 for review.	<b>Achieved</b>
		<b>2-year plan:</b> Confirm resources required to maintain and enhance EMESRT resources and engagement processes.	<b>Achieved</b>
Objective 2	Review and refresh EMESRT Design Philosophy (DP) content and style, including: <ul style="list-style-type: none"> <li>• Completing a survey/review of DP users and reconfirming audience, e.g. designers</li> <li>• Where possible, linking to examples where DP is applied</li> <li>• Improving support material where required, e.g. replacing stock photos with illustrations that better summarise design improvement opportunities</li> </ul>	<b>Short term:</b> <ul style="list-style-type: none"> <li>• Update specific topic areas discussed during planning workshop, e.g. tyres and rims, equipment fires, gender neutral equipment</li> <li>• Include topics not discussed in detail, e.g. functional safety, cab controls to manage exposure to silica</li> <li>• Confirm relevant anchoring DP</li> </ul>	<b>Achieved</b> - all items discussed and prioritised at the August EAG Planning workshop
		<b>2-year plan:</b> <ul style="list-style-type: none"> <li>• Review and refresh DP content and style</li> <li>• As required, review specific topic summaries and prepare performance requirements, e.g. equipment fires, managing tyres and rims, and other topic areas where the existing DP's do not provide enough detail for designers to fully understand the performance requirements</li> </ul>	<b>Ongoing</b> - Work commenced in October 2018  Note the CFw process is expected to provide detailed information that is complementary to and supporting of the EMESRT Design Philosophies
Objective 3	Confirm evolution of EMESRT approaches – review and refresh EMESRT key methodologies based on extensive work to establish the vehicle interaction control workplan and previous successes, with input from all EAG members covering: <ul style="list-style-type: none"> <li>• Confirming vehicle interaction case study approach, and establishing position on aligning/integrating it into ICMM Critical Control Management (CCM) framework</li> <li>• Aligning application of tools such as EDEEP and OMAT with new control thinking (ICMM CCM)</li> <li>• Capturing knowledge and experience of long term EAG members</li> <li>• Documenting evolution of EMESRT methodology, e.g.               <ul style="list-style-type: none"> <li>- Using industry level landscape mapping to identify interconnects and opportunities for new projects</li> <li>- Enhancing problem definitions for designers by confirming functional requirements</li> <li>- Identifying and managing stakeholders (Objective 4)</li> </ul> </li> </ul>	<b>Short term:</b> Review ICMM Vehicle Interaction Workplan proposal to identify how EMESRT approach has changed over the last 5 years.	<b>Achieved</b> - Review completed
		<b>2-year plan:</b> Update EMESRT methodology, processes and tools, and illustrate their application through real-world case studies.	<b>Achieved</b> - Note the development of the EMESRT CFw approach
Objective 4	Prepare a formal EMESRT stakeholder approach method to improve EMESRT profile for member companies and industry associations.	<b>Short term:</b> <ul style="list-style-type: none"> <li>• Working examples provided by members for further EMESRT development</li> <li>• Practically apply this approach for current vehicle interaction control project, such as for ICMM conference presentation in November 2017</li> </ul>	<b>Achieved</b> - Some delays experienced through EAG representative changes
		<b>2-year plan:</b> Update EMESRT methodology - seek new member advice, and further external support as required.	<b>Further work required</b>

## 2. EMESRT INDUSTRY-LEVEL PROJECTS (2018 PROGRESS TO PLAN)

REFERENCE	DESCRIPTION	NEXT STEPS	STATUS AT 31 DECEMBER 2018
Project 1	<p><b>Summary:</b> Vehicle Interaction Control Improvement Project</p> <p><i>This incorporates all EMESRT work to date, including developing ISO 21815 industry interface protocol and control level models.</i></p>	<p><b>Short term:</b> Complete these actions before end of October 2018:</p> <ul style="list-style-type: none"> <li>Update potential user guide replacement from ACARP C26028 PDS Validation Testing Framework and communicate next steps intent</li> <li>Building from landscape diagram project summaries, prepare stakeholder management plan</li> </ul> <p>Prepare ICMM conference information for attendees:</p> <ul style="list-style-type: none"> <li>Modify short collaboration proposal to include operational innovation support by new and existing technology (level 1-6 controls)</li> <li>Include some details of the EMESRT approach and successes in presentation, e.g. OEM rules and engagement</li> </ul>	<b>Achieved</b>
		<p><b>2-year plan:</b> For vehicle interaction control improvement project, confirm:</p> <ul style="list-style-type: none"> <li>Build from acceptance by ICMM of collaboration proposal in March 2018</li> <li>Complete detailed planning, including resourcing</li> </ul>	<b>Achieved</b> - The EAG's are members of multiple working groups for the ICMM ICSV programme. EMESRT is providing direct funding to deliver early outcomes for the ICSV Knowledge Hub.
Project 2 - key step	<p>Detail: Vehicle Interaction control - Design Functional Requirements.</p> <p>As key part of Project 1, enhance industry problem definition understanding for vehicle interaction controls by defining functional requirements.</p>	<p><b>Short term:</b> Source latest developments from member companies based on ICMM Critical Control Methodology:</p> <ul style="list-style-type: none"> <li>Review and format for distribution and in-company review and feedback by other EMESRT members</li> </ul>	<b>Achieved</b> - Note that this work led to the development of the new Control Framework approach.
		<p><b>2-year plan:</b> Confirm and establish an industry reference standard for vehicle interaction functional requirements that:</p> <ul style="list-style-type: none"> <li>Can be used by designers</li> <li>Will become a key organising methodology for the project</li> </ul>	<b>Achieved</b>

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