ICMM Mining with Principles

12 July 2023

Delivering Capable Vehicle Interaction Outcomes

Tony Egan - EMESRT VI Lead – ICMM ICSV VI Co-Chair (Glencore)

Innovation for Cleaner Safer Vehicles programme
Vehicle Interaction Working Group

International Council for Mining & Metals

Our vision is a safe, just and sustainable world enabled by responsibly produced minerals and metals.

Each of our company members – which together account for one-third of the global industry – commits to implementing the Mining Principles as a condition of membership. These principles are neither static nor do they represent the ceiling of our ambition. We are always challenging ourselves to go ever further in setting the highest of standards for responsible mining, and delivery.

We promise to work collaboratively with associations and other stakeholders to enhance the contribution of mining and metals to sustainable development. Our commitment to working with others does not stop at our industry's boundaries. We were founded on a spirit of open engagement, and we continue to champion diversity of opinions today to deliver bold leadership for our wider industry and non-resources sectors alike.

Focus areas

Our Approach

Working to strengthen the social and environmental performance of the mining and metals industry. ›

Who We Are

Our purpose is leadership through collaboration to enhance the contribution of mining and metals to sustainable development. ›

Our Members

We bring together a third of the global mining and metals industry to deliver leadership, action and innovation for a safe, just and sustainable world. ›

ICMM

Initiative for Cleaner Safer Vehicles

In October 2018, the ICMM launched the Innovation for Cleaner, Safer Vehicles (ICSV) programme.

ICMM member mining companies and the ICSV ambition is that by 2025 vehicle interaction technology is available that supports industry operational practices.

Ongoing collaboration with EMESRT to develop practical resources that assist sites to integrate technology while supporting the development of Capable Solutions for global market uptake.

Three year strategy (2023-25), will leverage this collaboration by asking "*Leading Sites*" to apply and adapt these resources and share lessons learned.

ICSV Vehicle Interaction Programme Outcomes Nov 2022

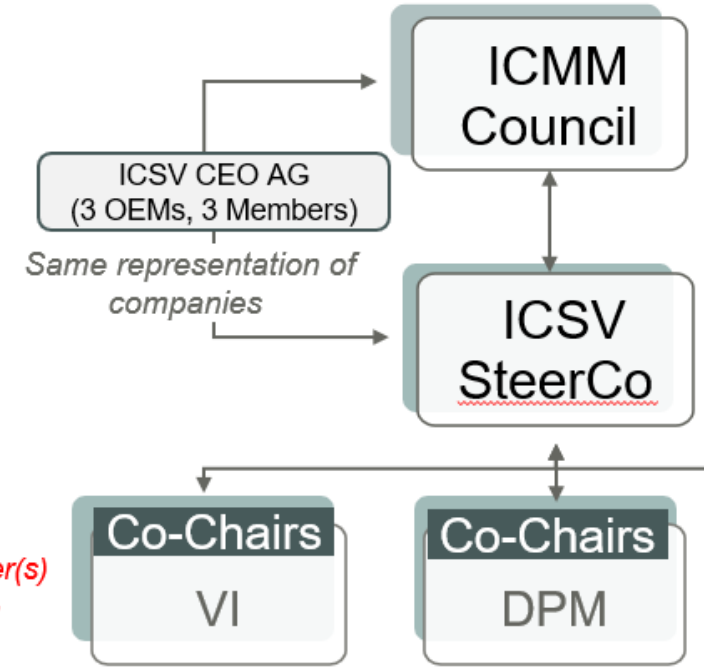
Strategy: Leverage momentum in leading sites to drive the adoption of capable solutions to have them **ready** for global market uptake by 2025.

Area of Work	Key Activities	Org. Involved	Outputs	Outcome 2022	Outcome 2023	Outcome 2024	Impact
Vehicle Interaction	Agree on guiding principles and success factors Preparation of CEO Commitment invitation Leadership and policy Applying supporting resources Sharing experiences Increasing industry capability Review ICMM Maturity Framework VI Control Baseline Mapping Surface functional performance scenarios VI Control Baseline Mapping UG functional performance scenarios Operational Integration Human Factors optimisation Technology partnerships Interoperability update Role of safety standards Early adopters to commit Leading Sites programme and provide feedback to improve overall process	ICMM Members OEMs EMESRT Third party technology providers Regulators	CEO Letter of commitment Resources and information Knowledge Hubs VI Control Baseline Process Industry User Requirements Map of Prioritised Sites by region Stakeholder engagement plan Updated White Paper defining Capable Solutions	Council formally supports the VI strategy centred on Capable Solution Processes At least 20 sites (ICMM 650) are nominated OEM have agreed alignment in key areas for Vehicle Interaction Third party Tech align to key areas for VI Capable Solutions Mid management understanding of integrated approach Levels 1-7 Regulator briefing strategy prepared to support ICSV approach	Deploy Capable Solution Processes A further 20 sites are nominated OEM design upgrades consider ISO interfaces Market reference to Functional Performance Scenarios Operations prepare VI Baseline and User Requirements Regulators **briefed** on ICSV approach	Improve and maintain Capable Solution Processes A further 20 sites nominated OEMs are ready to expand ISO interface Tech providers compete to drive performance Operations successfully deploy Capable Solutions Regulators **aligned** with ICSV approach	Vehicle Interaction Capable Solutions are commercially available at scale to Technology Readiness Level 9 (TRL-9) Industry level processes are embedded to drive their global deployment.

ICSV GOVERNANCE Links to Vehicle Interaction - Leading Site Subgroup

Role of AG

1. Provide guidance to the ICSV SteerCo on strategic issues
2. Make recommendations to the ICMM Council



Role of Council

1. To make decisions based on the recommendations of the Advisory Group

Role of Steerco

1. To drive the ICSV strategy and program overall
2. Framing and discussing key strategic matters with the Advisory Group,
3. Provides oversight of the Working Groups.

ICMM Leadership Support:

1. *Dedicated Capable Solution Project Manager(s)*
2. *Capable Solution process execution funding and resource coordination 2022-25*

Role of WG:

1. Implement the strategy
2. Provides detail analysis
3. Provide traction to all activities inside each company

Vehicle Interaction Leading Site Subgroup Role - Nov to Dec 2022

1. Provide company representative (corporate) contact with alternate as members of the VI Subgroup – confirm nominees by December 2022
2. Communicate ICSV Leading Site Strategy and expectations for nominated sites to multiple audiences – slide pack distributed by December 2022
   a) Leading Site, Company, and Industry benefits
   b) Understanding and applying Capable Solution resources at site
   c) Progress reporting against stage gates
   d) Process improvement feedback
3. Schedule Q1 2023 regional meetings to confirm process feedback requirements and develop stage gate (key performance indicators)

Vehicle Interaction Leading Site Subgroup Role – Calendar Year 2023

4. Companies confirm formal project launch of Leading Sites, with CEO endorsement
5. Confirm project timeline for nominated Leading Sites
6. Attend ICSV VI regional meeting with Project Managers from Leading Site(s)
7. Confirm progress reporting against stage gates monthly
8. Develop feedback processes for Capable Solution resources
9. Share learnings from Capable Solution deployments
10. Continue to brief all industry stakeholders and ICSV VI Working Groups
11. Briefing of next cohort of Leading Sites (region or commodity)

Leading Sites Program - Capable Solution

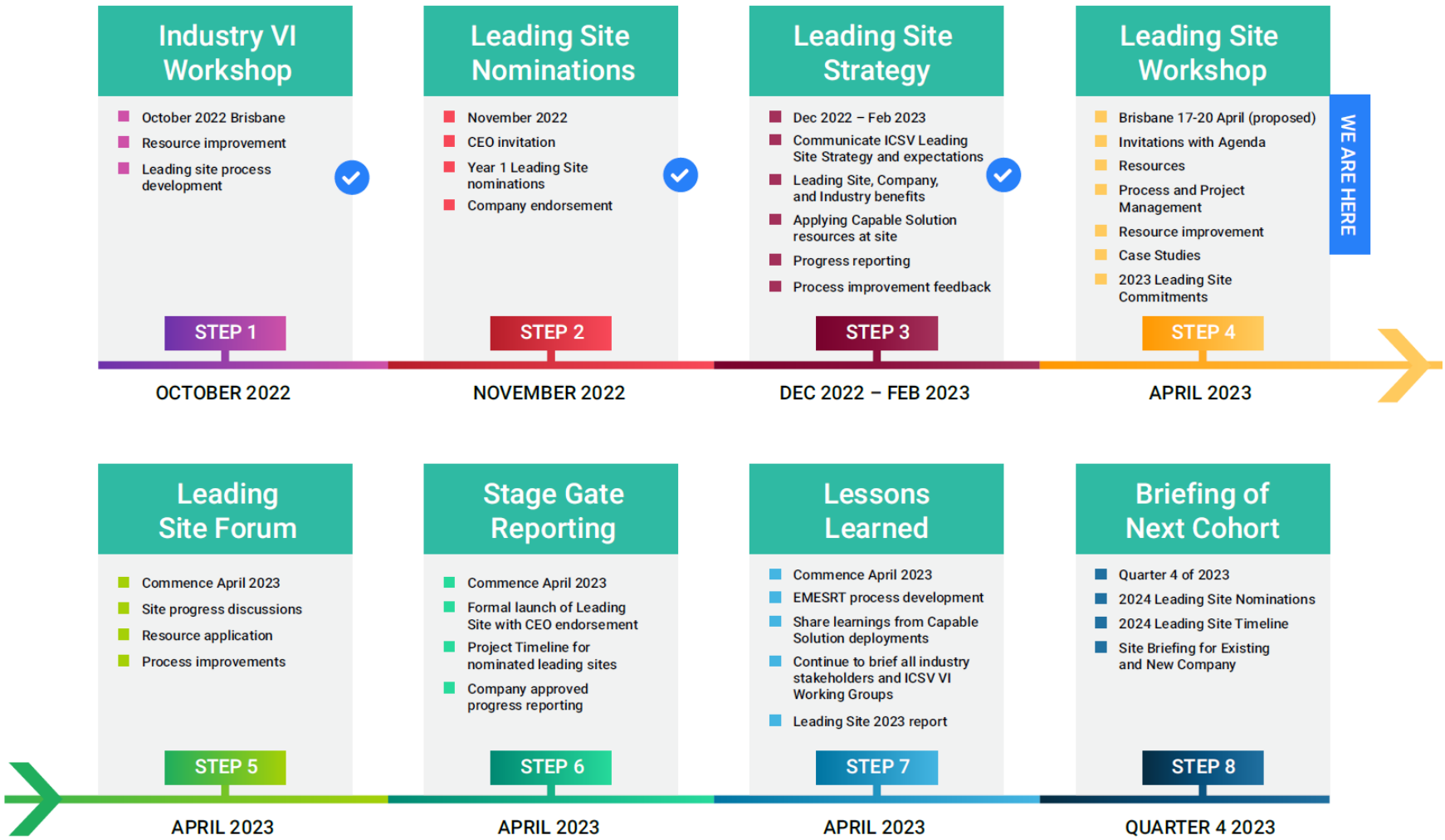
What is meant by a vehicle interaction '*Capable Solution*' ready for global market uptake?

- A capable solution delivers better vehicle interaction control performance by improving the quality of decision-making from task execution through to mine operations and design.
- A capable solution considers relevant aspects of the operating environment, production requirements and equipment design.
- Where technology is a part of a capable solution, it is operationally integrated with existing controls

Leading Sites Program Elements -2023

The ICMM ICSV Vehicle Interaction Control Improvement:
Leading Site Process and Timeline 2022 to 2023

ICMM



Introducing EMESRT Role

- A mining industry body set up in 2006 to influence how Original Equipment Manufacturers (OEMs) design and build their products
- It presents a common industry voice and is focused on:
  - Reducing health and safety risks from operating and maintaining mining equipment
- It delivers practical outcomes by:
  - Connecting a community of; end users, OEMs, researchers, and third party suppliers
  - Setting industry level goals and then coordinating their delivery, project by project

EMESRT VI Project Timeline

2006 Establishment

Fully funded industry entity
Common voice engagement process
OMAT beyond standards
Design philosophies
- Access & Working at Heights for surface mobile equipment

2009 Evaluation of OEM Design

Design evaluation linked to procurement through OMAT/EDEEP
14 members of EMESRT
- EMESRT nine level control model

2017 OEM and PDS Interoperability

Control Levels 7-9 Focus
- Performance requirements PR-5 developed to supplement DP-5
- One-on-one briefings with OEMs
- One-on-one briefings with PDS
- 1st OEM- PDS workshop to initiate development of interoperability protocol
- 2nd interface workshop
- 3rd interface workshop

2021 Project Next steps

EMESRT Led
- EMESRT Vehicle Interaction Control Framework (CFw)
- EMESRT Knowledge Hub based on Journey Model navigation aid
- VI Self-Review Tool for review project baseline

EMESRT Influenced
- VI Functional Safety project
- ICSV Workstreams

2006 2009 2011 2013 2015 2017 2018 2019 2020 2021 2022

2006 Focus areas

1. Surface Mining
2. Exploration Drilling
3. Underground Hard Rock
4. Underground Coal & Soft Rock

Eight design philosophies
Some work on Tyres and Rims with ACARP

2015 PDS Suppliers

Third party proximity detection suppliers (PDS)
Vehicle Interaction "burning platform" established
1. Clearly define the problem
2. Understand the scenarios
3. Build a set of performance requirements for evaluation

2019 VI Control Improvement Project

Controls at Levels 1-7
- ICMM Collaboration
- Enhanced problem definition including functional performance requirements

Controls at Levels 8-9
- ISO 21815 interface protocol support

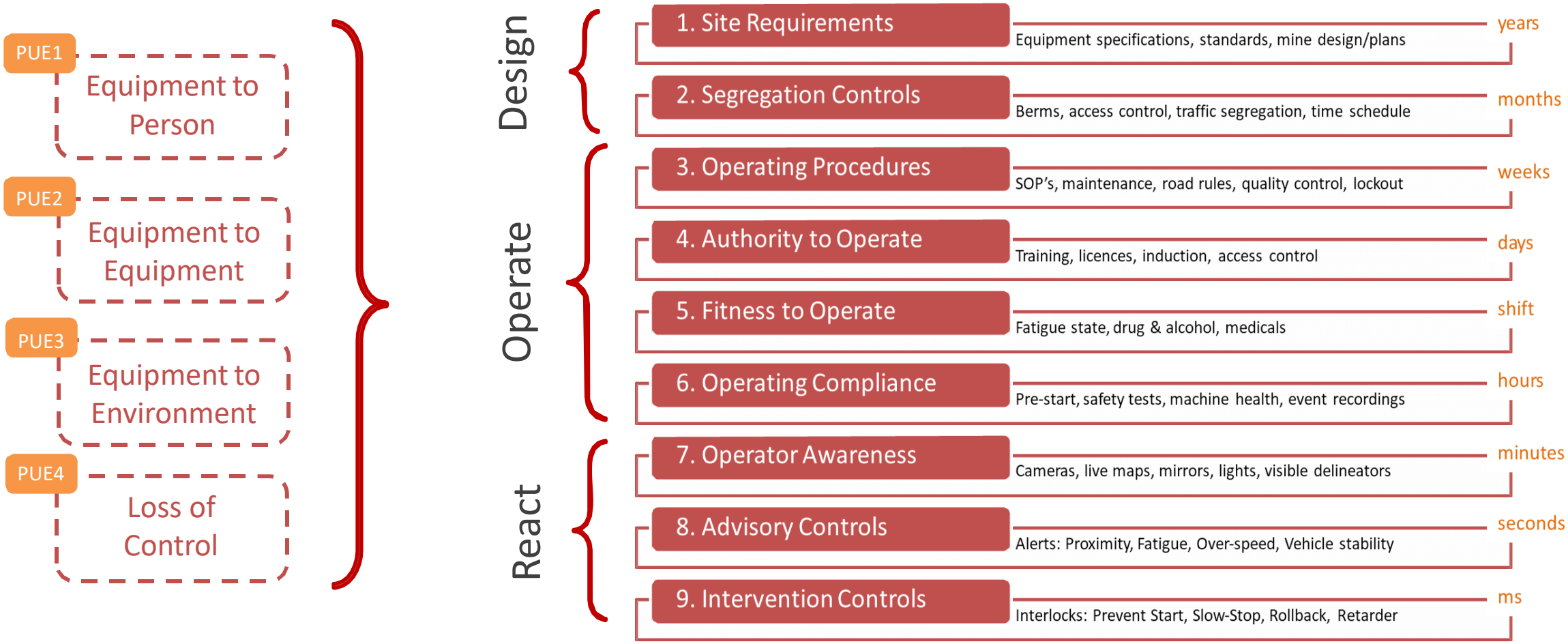
Industry Project Collaboration
- ICMM Technology Acceleration Summits
- ICMM ICSV Collision Avoidance
- ICSV Maturity Framework
- ICSV Knowledge Hub
- Release of updated EMESRT PR5A (performance requirements)

Proximity Detection System Validation
- ACARP C26028 PDS testing methodology validation framework project

2022 Project Next steps

- Review and update Design Philosophy 5: Machine Operation and Control
- With ICMM, deliver regular topic specific webinars to industry, e.g. developing/understanding your baseline (maturity framework)
- Delivery phase of the VI improvement strategy
- Functional Performance Scenario Storyboards
- PDS Validation Guideline

The EMESRT 9 Layer Model of VI Control Effectiveness – 2015



- Dynamic interdependence between control levels
- Control categories operate in different timeframes

CONTROL EFFECTIVENESS = Exposure to Unwanted Events

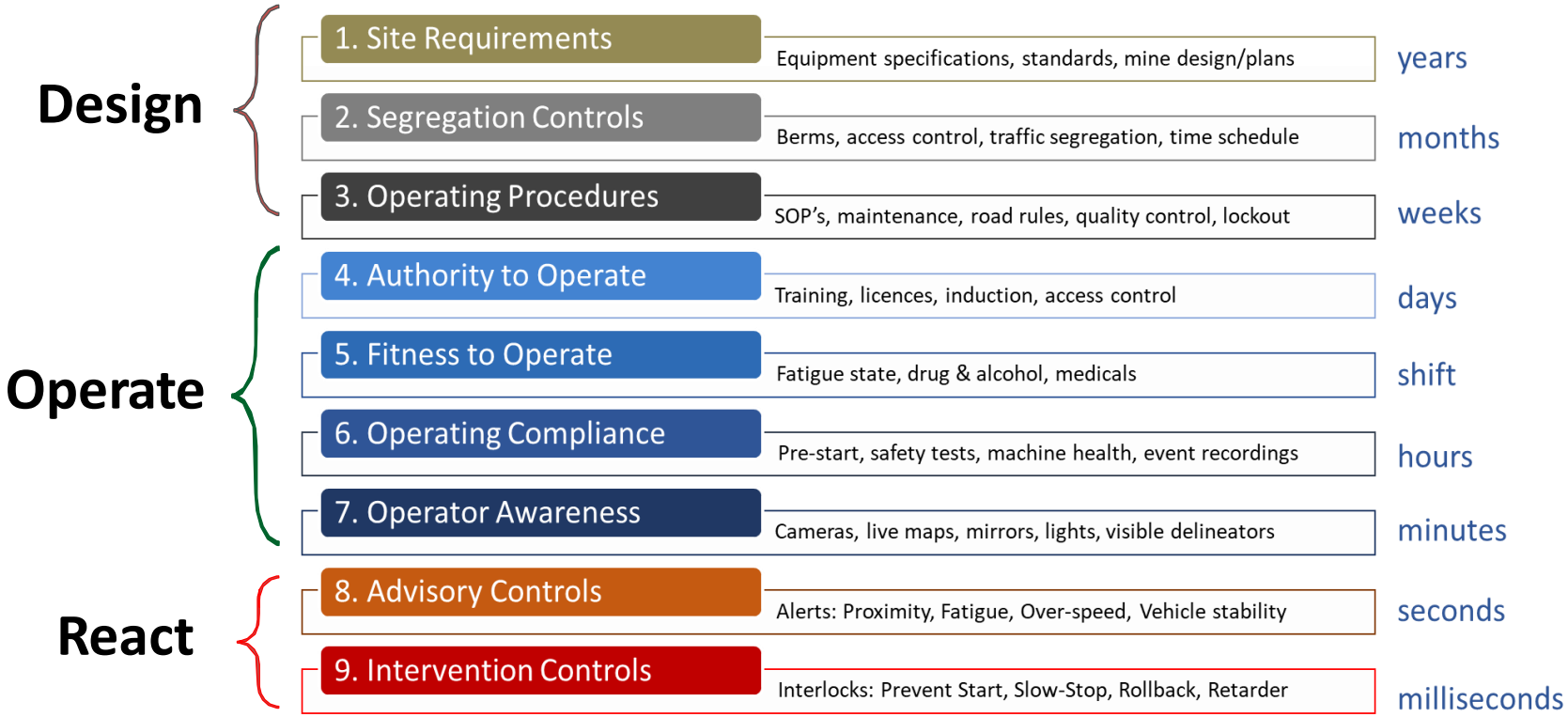
Lower Exposure

Higher Exposure

Key Concepts – The EMESRT Nine Layer Control Effectiveness Model

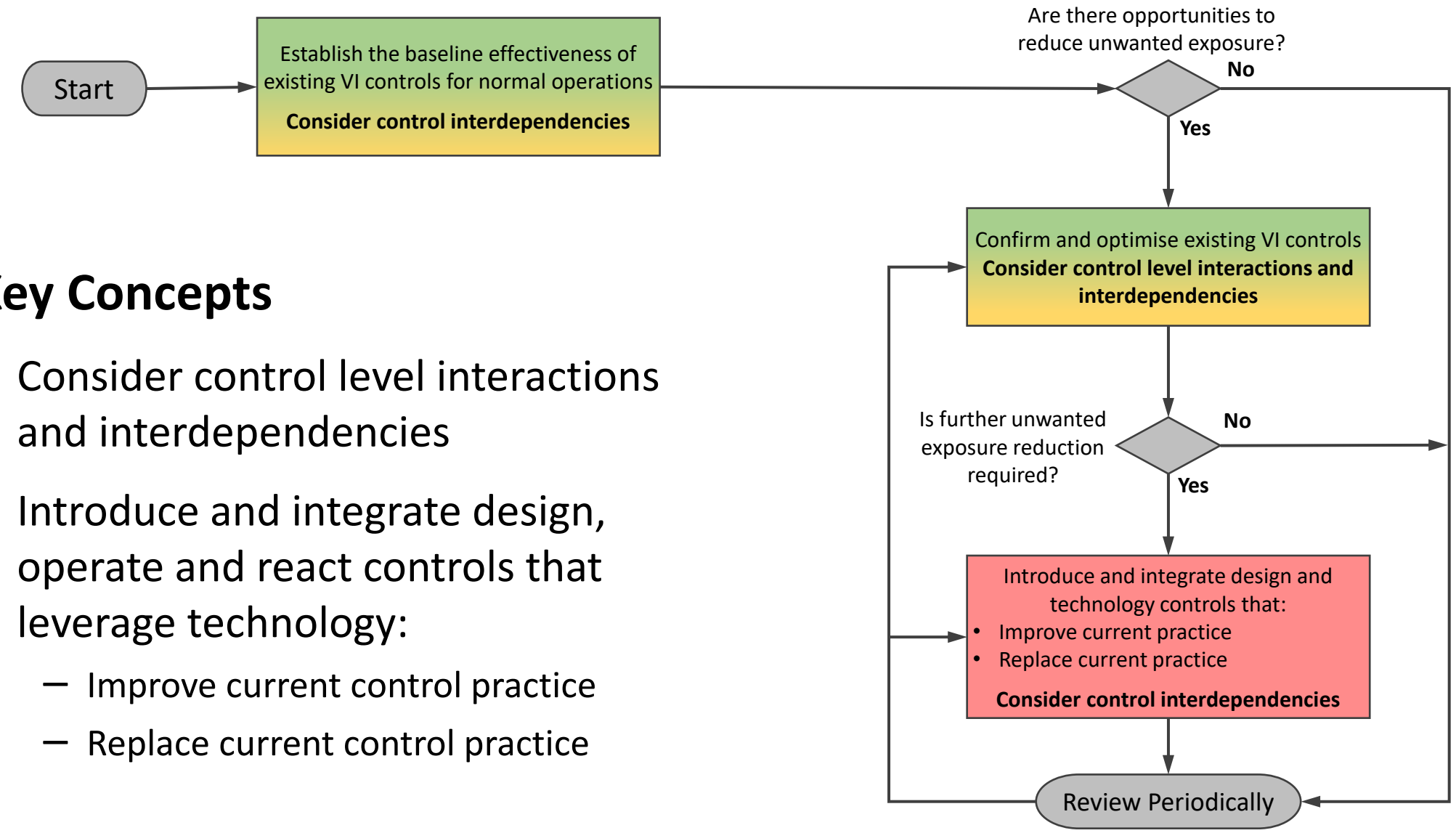
2019 Reframing our understanding of Vehicle Interaction Controls

- Dynamic interdependence between control levels
- Control categories operate in different timeframes
- High dependence on real time human factor decision making
- To implement Level 8 and 9 controls well, you need to first understand the effectiveness of your Level 1- 7 control baseline



A foundation concept to understand control effectiveness

2020 EMESRT VI Controls Assessment Process



Key Concepts

- Consider control level interactions and interdependencies
- Introduce and integrate design, operate and react controls that leverage technology:
  - Improve current control practice
  - Replace current control practice

The EMESRT Control Framework Approach – 2017 Development

A sector level refocus is taking place – ICMM 2015

It is based on a pivot from risk scoring to understanding control effectiveness

- Controls prevent or mitigate something bad happening
- Controls are specifiable, measurable and can be verified
- Understanding how controls fail –design issues, poor implementation, non-compliance, etc. is essential to improve their reliability

This 'new control definition' thinking is widely accepted and supported:

- Multiple resource companies are attempting to make it work, and
- It is influencing regulators across multiple jurisdictions

The challenge/opportunity is to practically deliver on its promise:

- In ways that focus the business inputs that prevent fatalities are both well-designed and being applied
- Using approaches that engage people and integrate with operations
- To systematically remove ineffective controls while delivering other business benefits

ICMM Health and Safety Critical Control Management –Good Practice Guide

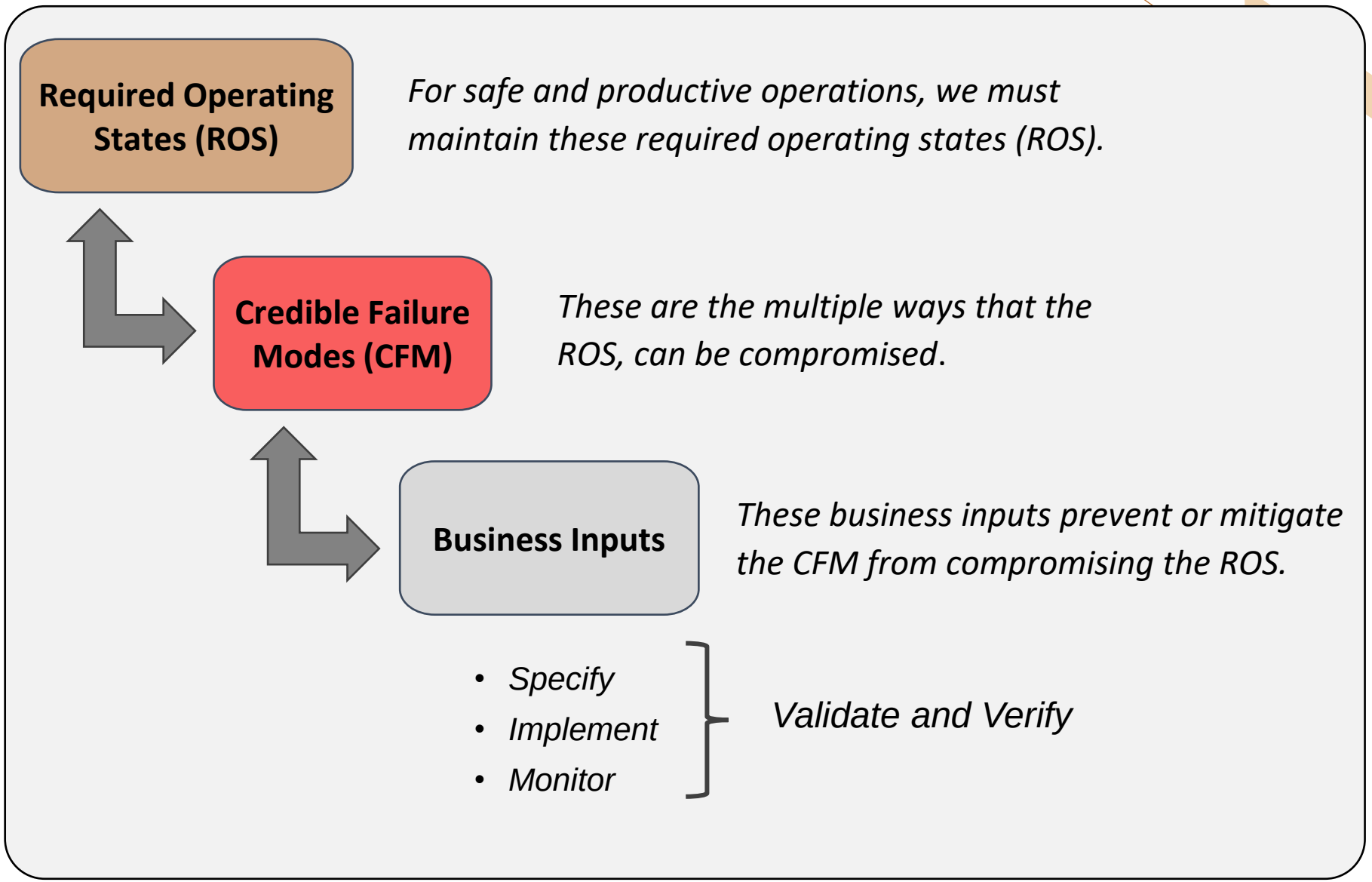
https://www.icmm.com/en-gb/publications/health-and-safety-critical-control-management-good-practice-guide

*"If I am the person who can be harmed, is this **a thing** that will always stop something bad happening?"*

The EMESRT Control Framework (CFw) Approach

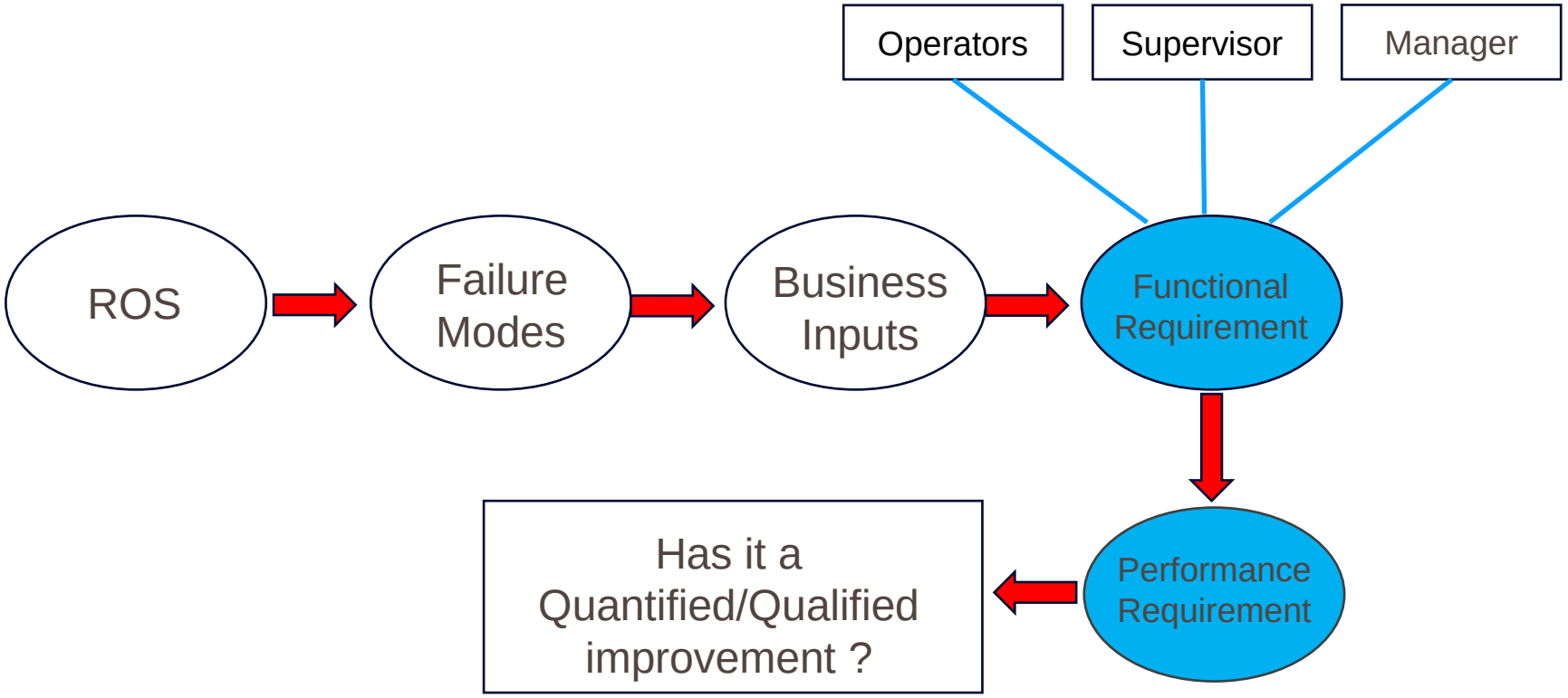
Organising questions

1. What is our business purpose?
2. What are the safe and productive operating states that deliver our business purpose?
3. What can cause failure?
4. What are the business inputs that prevent or mitigate failure?
5. How are these business inputs
   - ***specified***
   - ***implemented, and***
   - ***monitored***



"The Control Framework (CFw) approach was developed by EMESRT as a practical way to apply new control thinking."

Functional Performance Requirement Development



Functional Statements - 2017

Function Requirement	Related Control	Addressing Erosion Factor…	Control Sheet	Current Data Collection Method	Current Data Collection Frequency
As a Heavy vehicle operator I want to be warned when my speed of operation is outside site requirements particularly on approach to down sloping ramps or cross grades so that I can slow the speed of my vehicle or change its operating direction.	Operators drive vehicles at speeds which meet site conditions	Operator not aware of correct speed	3 Operators drive vehicles at speeds which meet site conditions	Self Observation	nil

Control Effectiveness – Managing Change

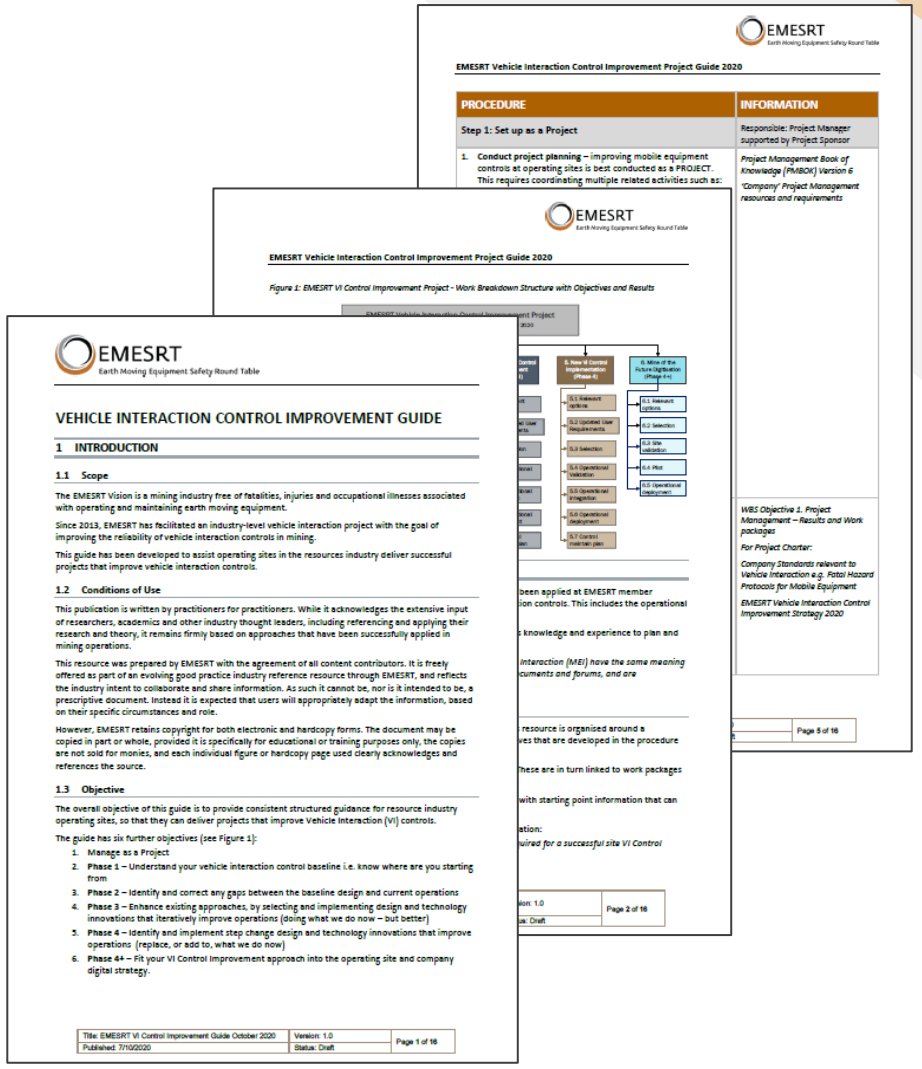
- Step 1 – Truly understand your "*Problem*" not just the "*Symptoms*"
  - Really challenging how effective are our current controls?
  - Even if the controls were performed as specified, do they really address the failure modes?
- Step 2 – Using the failure modes, identify options to address the ineffectiveness
- How can technology assist us?
  - "*Technology that helps us do better what we do now*" Levels 1-7
  - "*Technology that replaces what we do now*" Level 8/9

Key Resources – EMESRT VEHICLE INTERACTION CONTROL IMPROVEMENT GUIDE

The overall objective *of this procedure is to provide consistent structured guidance for operating sites, so that they can deliver projects that improve vehicle interaction (VI) controls*

This ***resource is based on processes*** *and approaches that have been applied at EMESRT & ICMM Member Company operations to systematically improve vehicle interaction controls. This includes the operational integration of new technology VI controls*

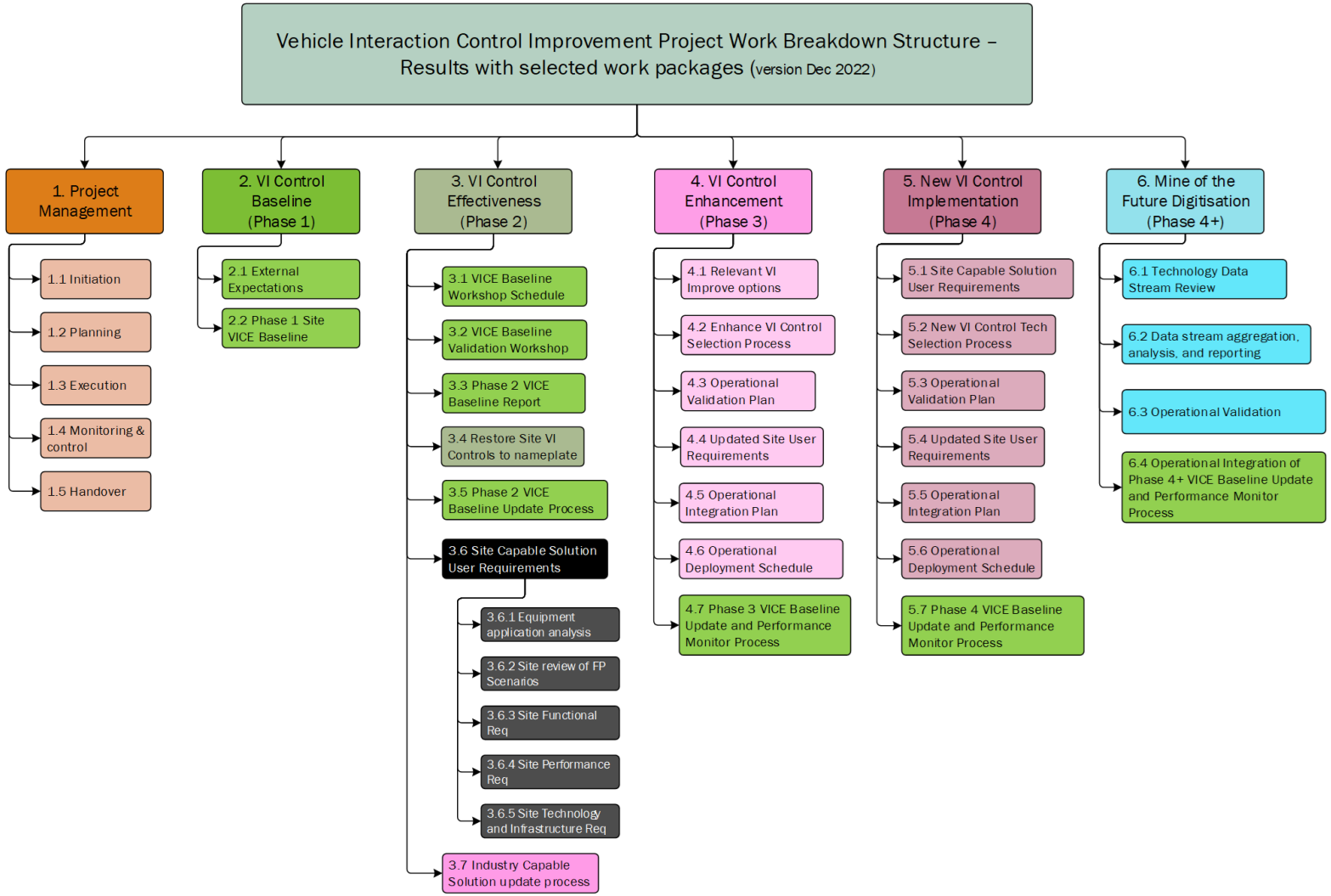
Expected users *are site and divisional leaders with the business knowledge and experience to plan and deliver complex business improvement projects*



VI Control Improvement Project – WBS for Project Managers

A Work Breakdown Structure with six objectives

1. *Project Management*
2. *VI Control Framework Baseline*
3. *Existing VI Control Effectiveness*
4. *Existing VI Control Enhancement*
5. *New VI Control Implementation*
6. *Mine of the Future Digitalisation*

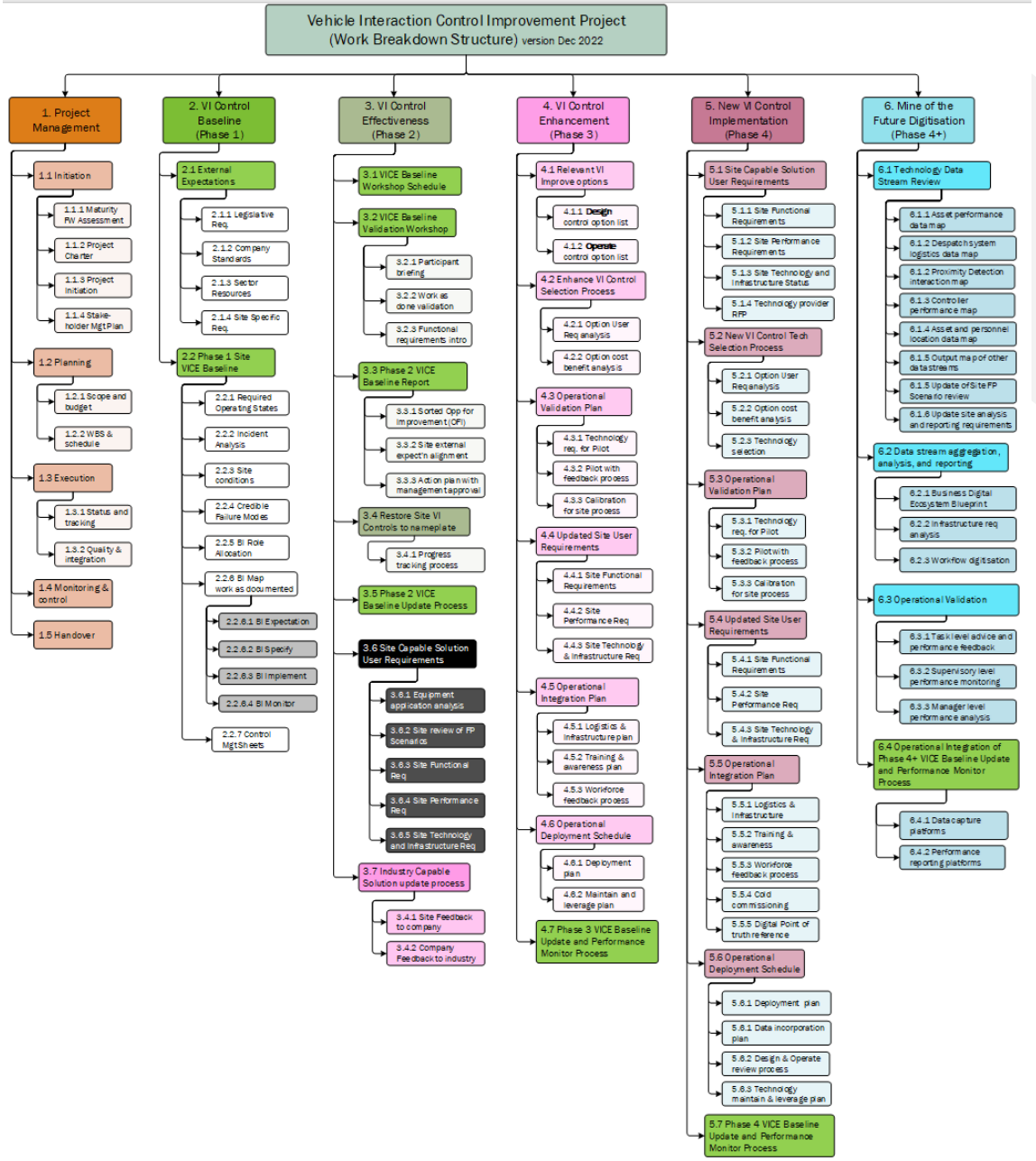


EMESRT Project Outputs - Work Breakdown Structure (WBS) Example

A Work Breakdown Structure (WBS) breaks complex projects into work packages

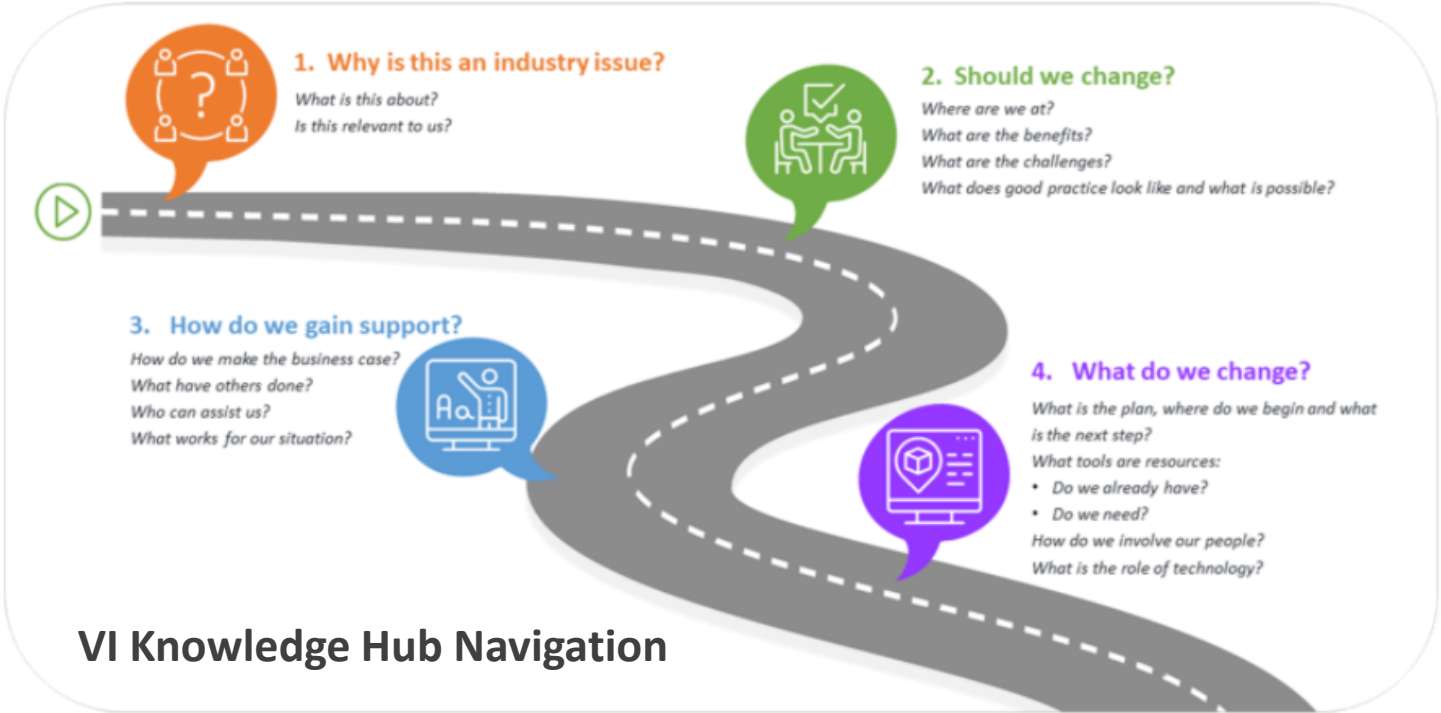
This example WBS has these objectives:

1. Manage as a Project
2. Understand your baseline i.e. where are you starting from
3. Identify existing operational improvements – plug the gaps, return to name plate performance
4. Identify and implement - iterative design and technology innovations
5. Identify and implement - step change design and technology innovations
6. Fit the approach into your broader company strategic approach



VI Knowledge Hub

- EMESRT has launched a beta version **Vehicle Interaction Control Improvement Knowledge Hub**
- It provides curated access to tools, case studies, reference information, links to relevant websites and other resources
- Navigation aids have been developed to assist a range of users to find relevant content
- Further resources will be updated for the “Leading Sites” workshop in April 2023



VI Knowledge Hub Navigation

CONTROL EFFECTIVENESS = Exposure to Unwanted Events

Lower Exposure

Higher Exposure

Exposure to unwanted vehicle interactions is directly determined by the effectiveness of all your interrelated controls


ICMM
Mining with
Principles