

Delivering Capable Vehicle Interaction Outcomes

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*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. >

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.

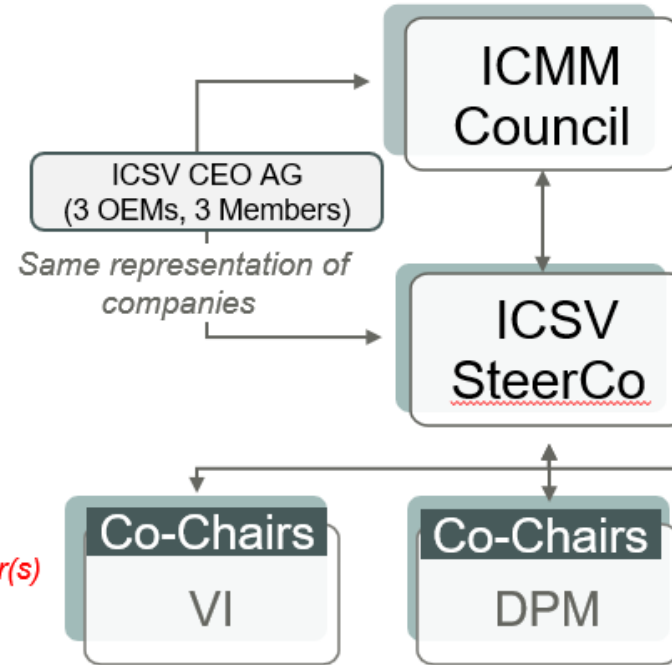
Area of Work	Key Activities	Org. Involved	Outputs	Outcome 2022	Outcome 2023	Outcome 2024	Impact
Vehicle Interaction	Agree on guiding principles and success factors	ICMM Members	CEO Letter of commitment	Council formally supports the VI strategy centred on Capable Solution Processes	Deploy Capable Solution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



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



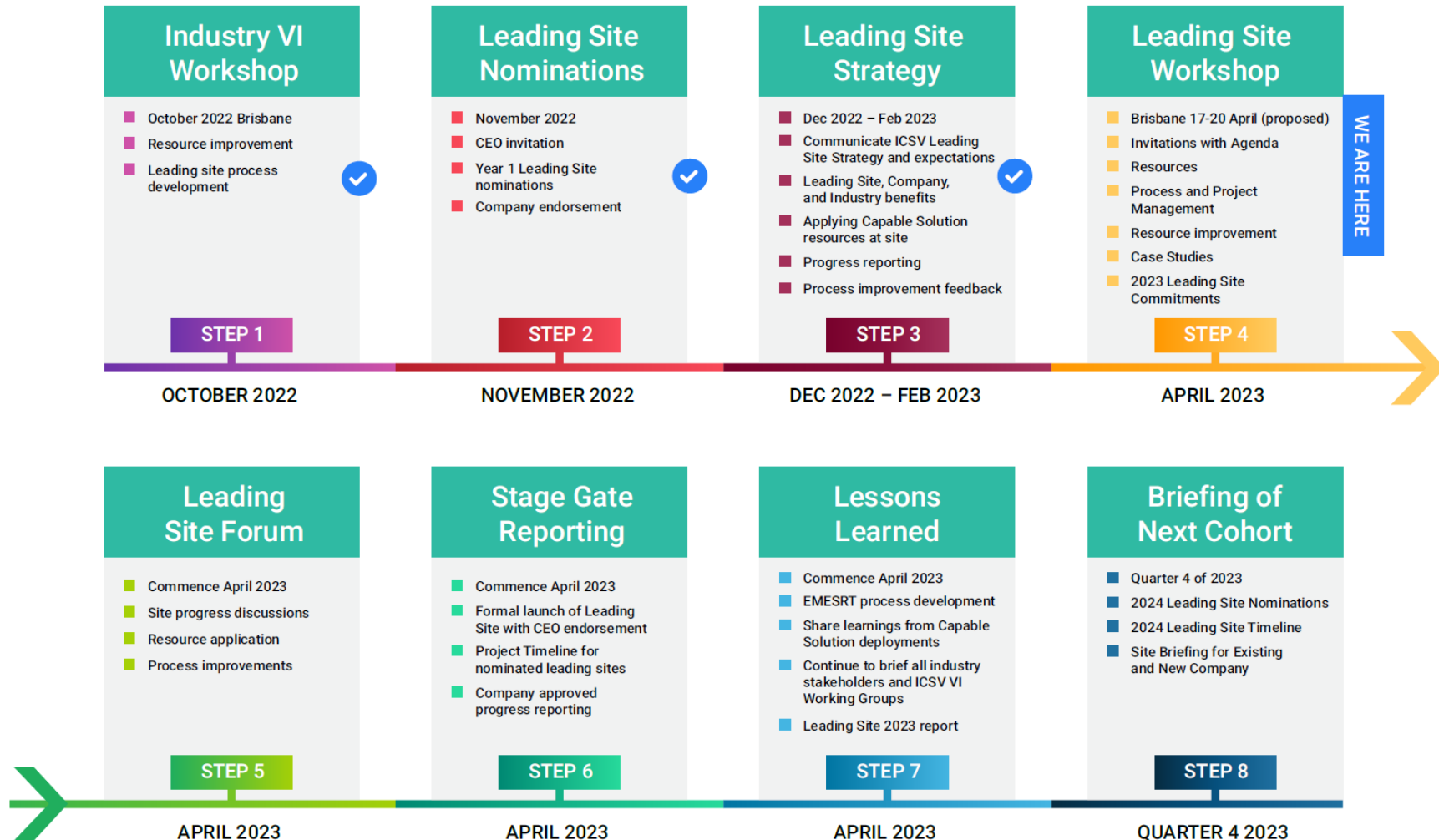
What is meant by a vehicle interaction '*Capable Solution*' ready for global market uptake?

- 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

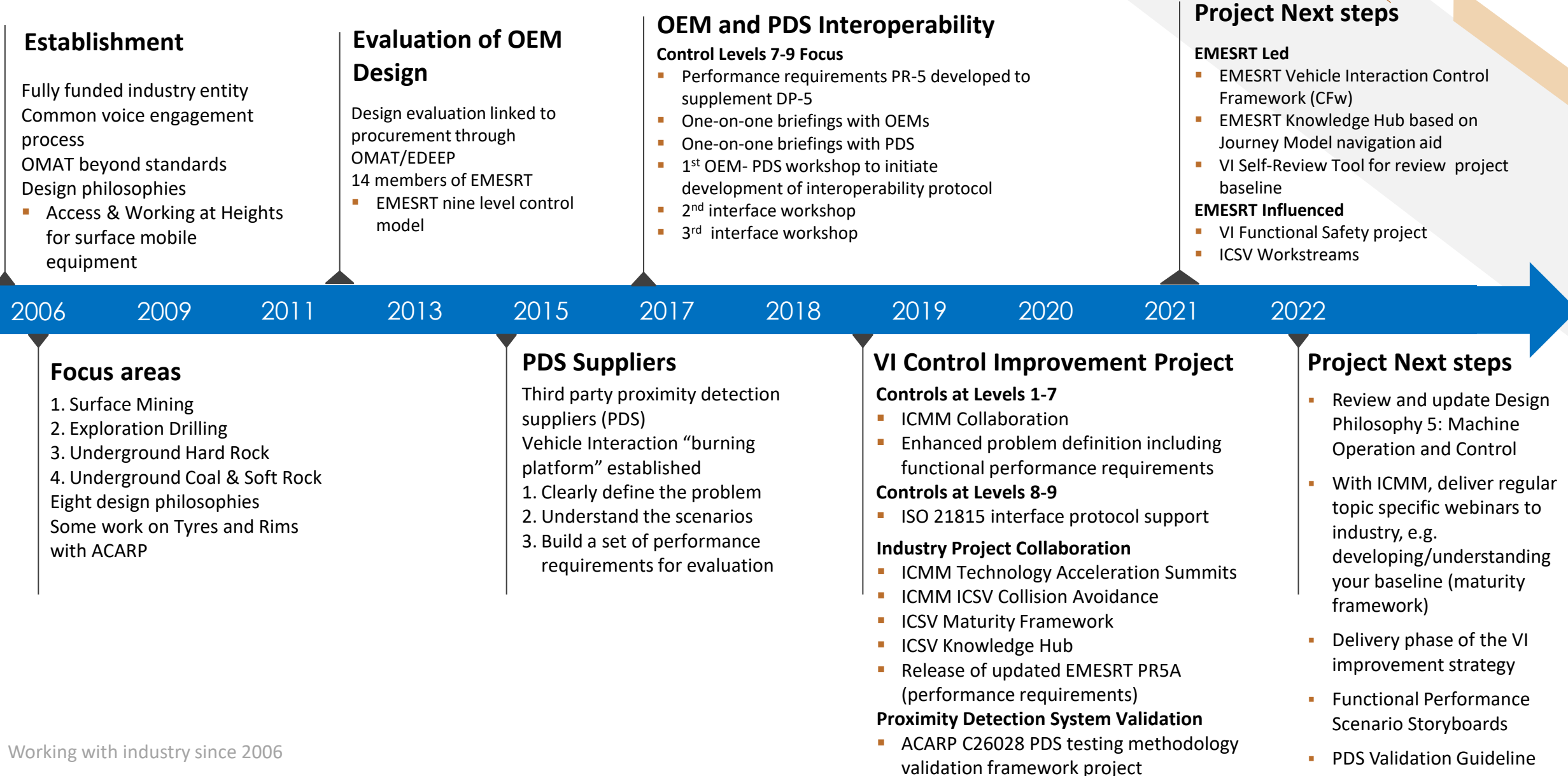


Introducing EMESRT Role

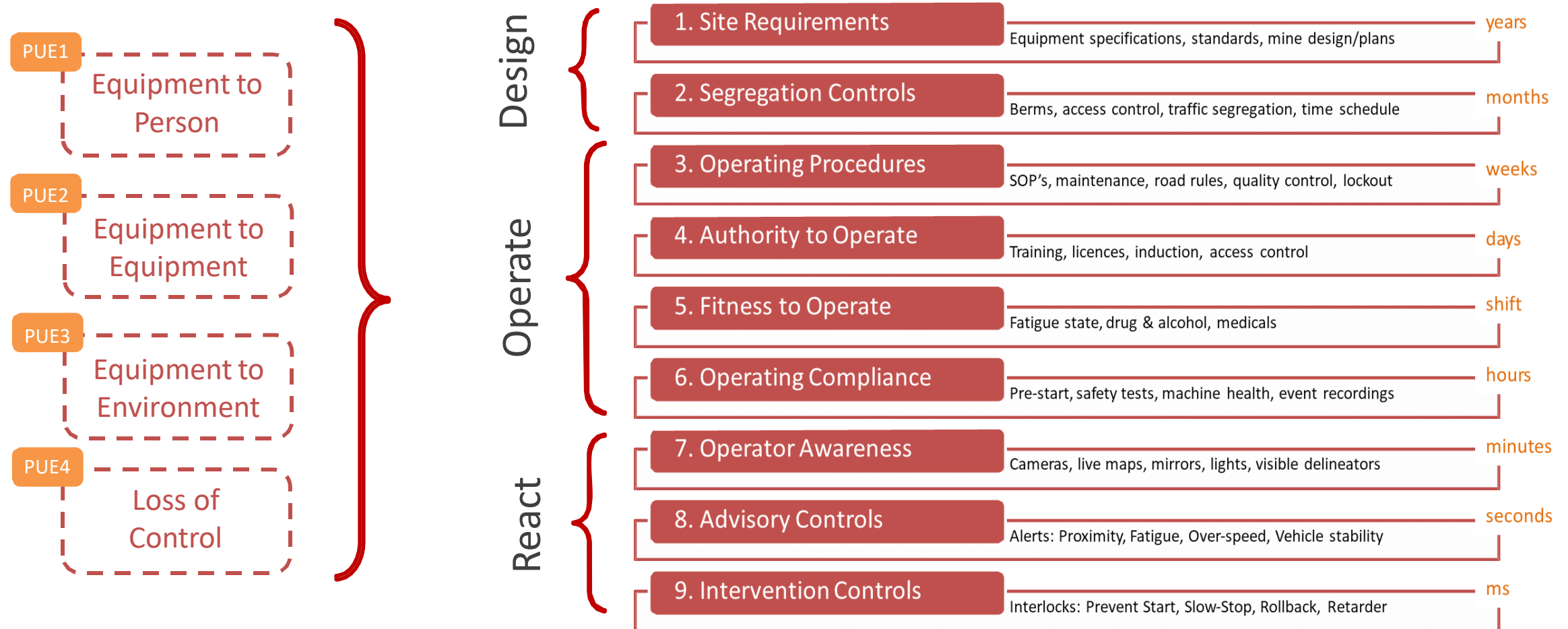
- A mining industry body set up in 2006 to influence how Original Equipment Manufacturers (OEMs) design and build their products
- It presents a common industry voice and is focused on:
 - Reducing health and safety risks from operating and maintaining mining equipment
- It delivers practical outcomes 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



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



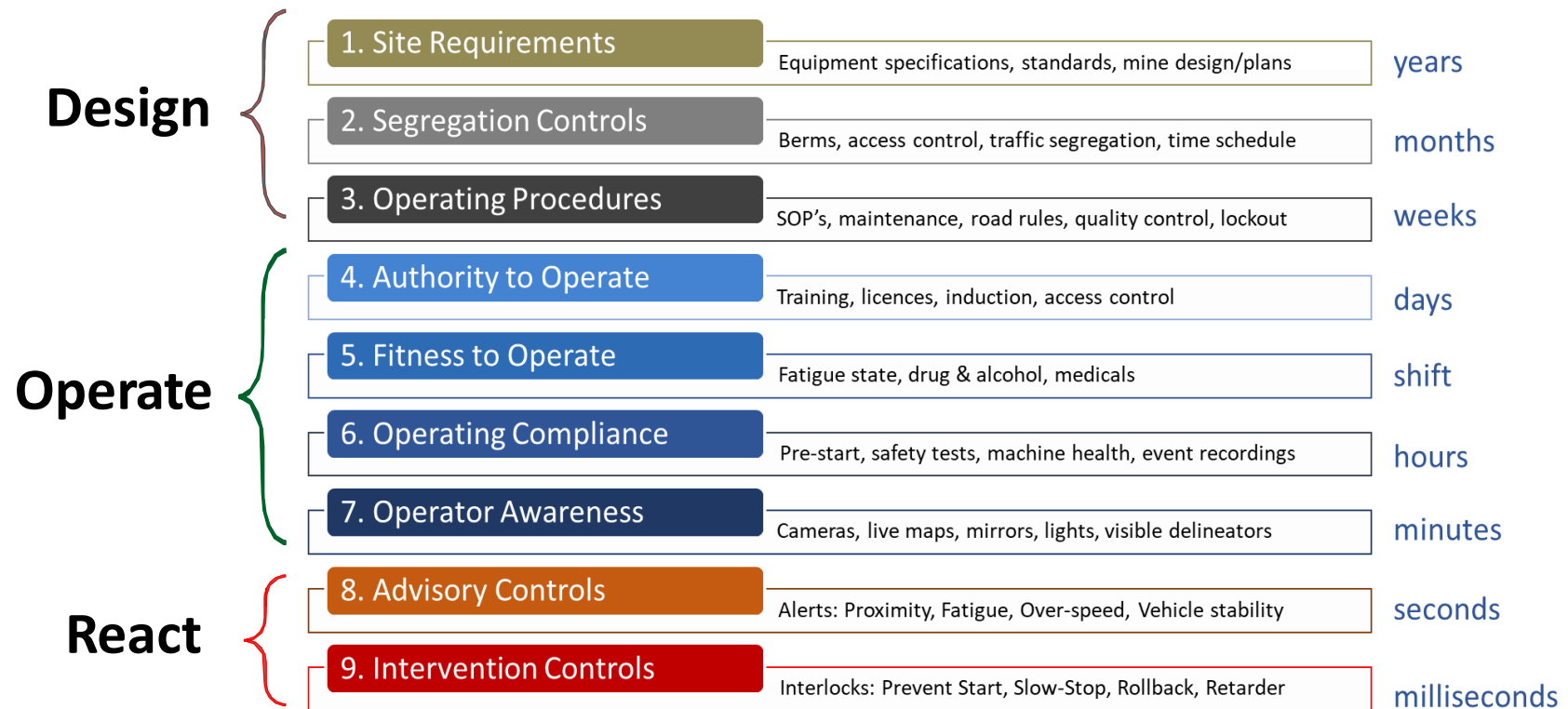
Higher Exposure



Key Concepts – The EMESRT Nine Layer Control Effectiveness Model

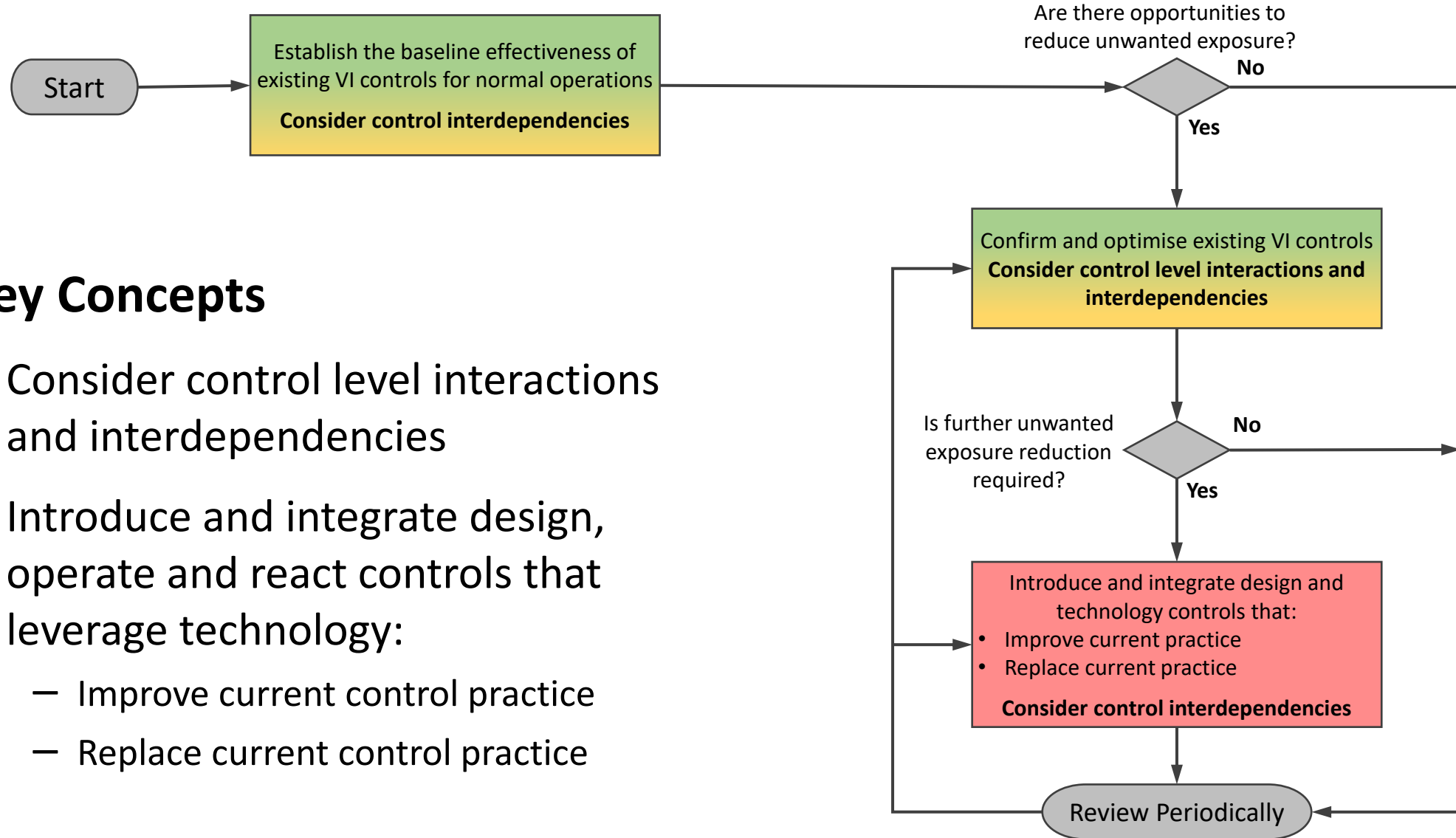
2019 Reframing our understanding of Vehicle Interaction Controls

- 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



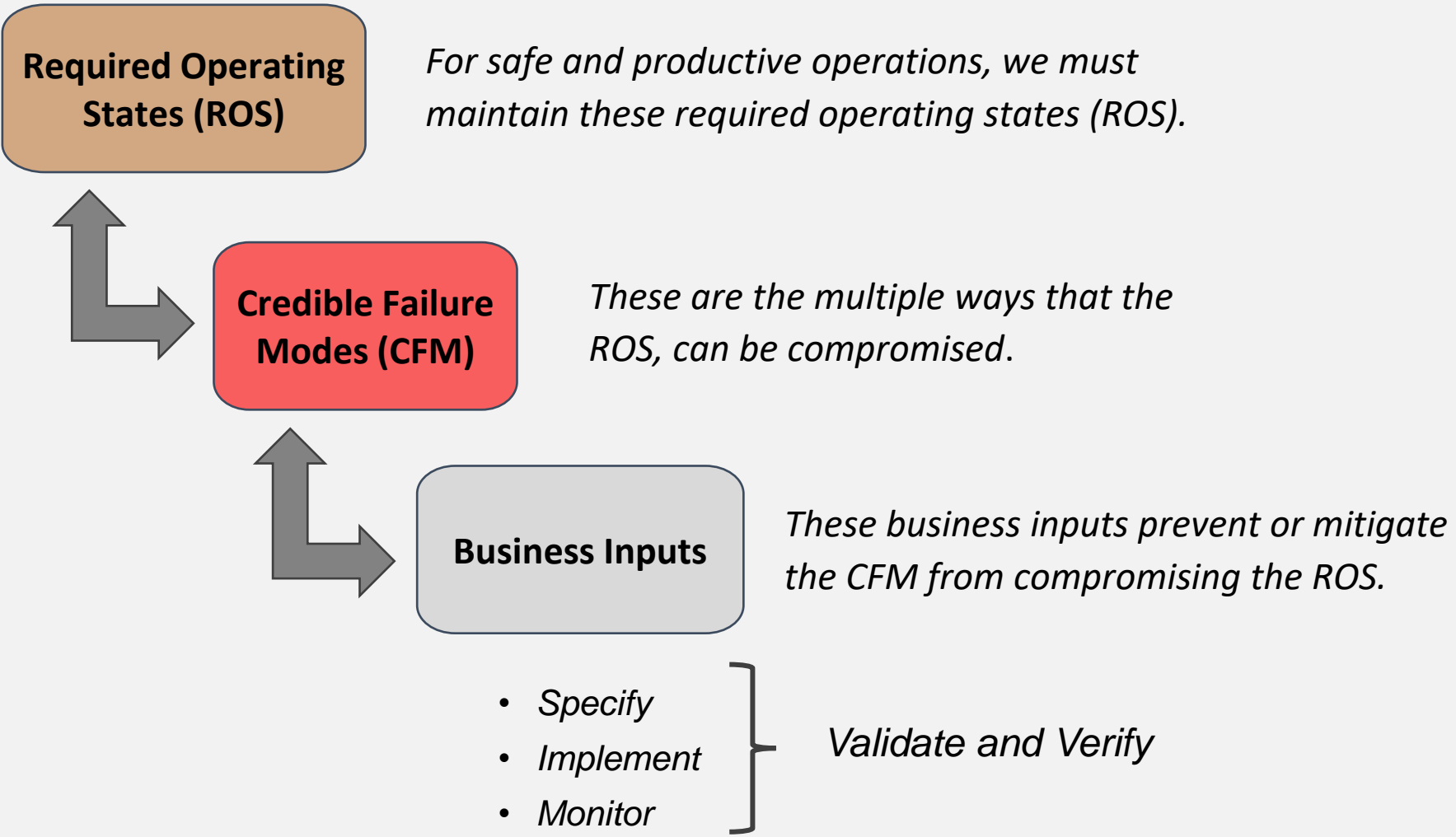
<https://www.icmm.com/en-gb/publications/health-and-safety-critical-control-management-good-practice-guide>

*"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

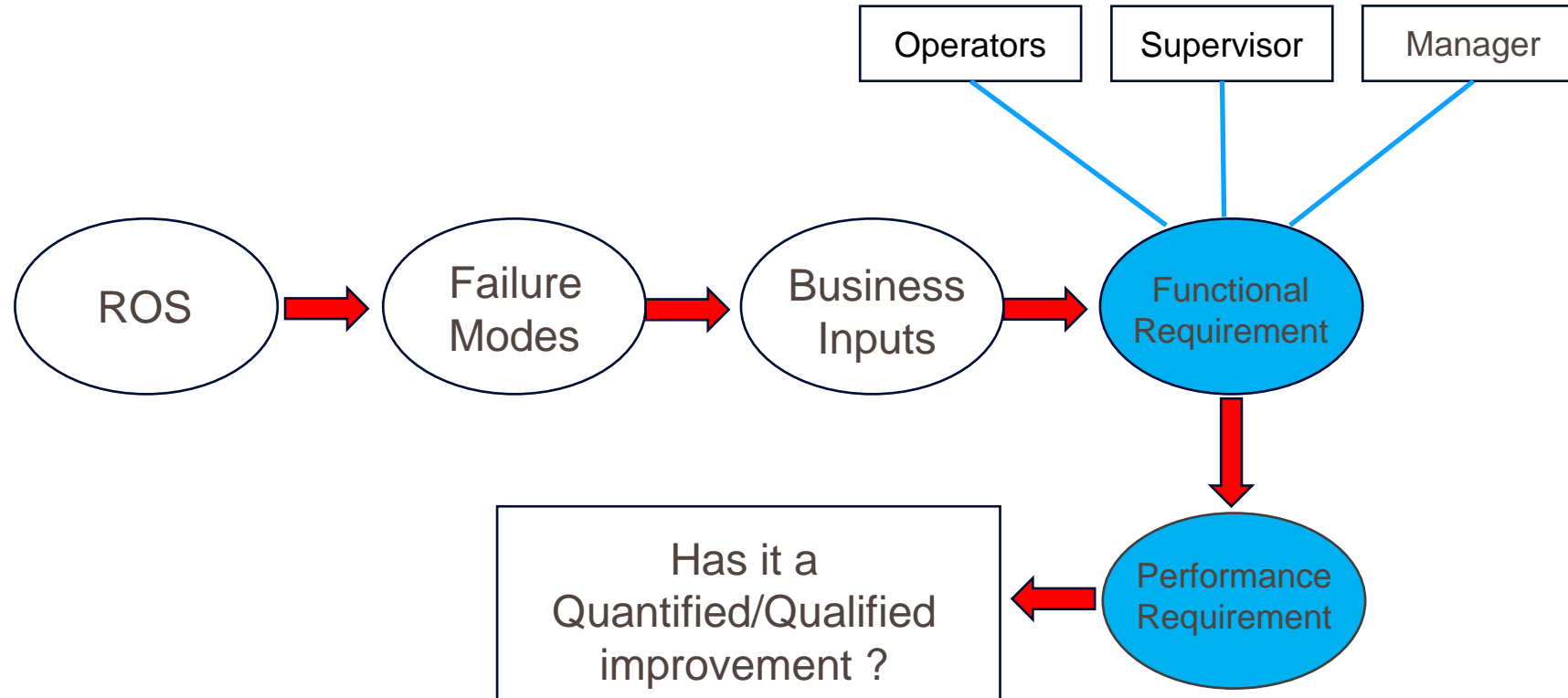
Organising questions

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

EMESRT
Earth Moving Equipment Safety Round Table

EMESRT Vehicle Interaction Control Improvement Project Guide 2020

PROCEDURE	INFORMATION
Step 1: Set up as a Project	Responsible: Project Manager supported by Project Sponsor
1. Conduct project planning – improving mobile equipment controls at operating sites is best conducted as a PROJECT. This requires coordinating multiple related activities such as:	Project Management Book of Knowledge (PMBoK) Version 6 Company Project Management resources and requirements

EMESRT
Earth Moving Equipment Safety Round Table

EMESRT Vehicle Interaction Control Improvement Project Guide 2020

Figure 1: EMESRT VI Control Improvement Project - Work Breakdown Structure with Objectives and Results

EMESRT
Earth Moving Equipment Safety Round Table

VEHICLE INTERACTION CONTROL IMPROVEMENT GUIDE

1 INTRODUCTION

1.1 Scope

The EMESRT Vision is a mining industry free of fatalities, injuries and occupational illnesses associated with operating and maintaining earth moving equipment.

Since 2013, EMESRT has facilitated an industry-level vehicle interaction project with the goal of improving the reliability of vehicle interaction controls in mining.

This guide has been developed to assist operating sites in the resources industry deliver successful projects that improve vehicle interaction controls.

1.2 Conditions of Use

This publication is written by practitioners for practitioners. While it acknowledges the extensive input of researchers, academics and other industry thought leaders, including referencing and applying their research and theory, it remains firmly based on approaches that have been successfully applied in mining operations.

This resource was prepared by EMESRT with the agreement of all content contributors. It is freely offered as part of an evolving good practice industry reference resource through EMESRT, and reflects the industry intent to collaborate and share information. As such it cannot be, nor is it intended to be, a prescriptive document. Instead it is expected that users will appropriately adapt the information, based on their specific circumstances and role.

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1.3 Objective

The overall objective of this guide is to provide consistent structured guidance for resource industry operating sites, so that they can deliver projects that improve Vehicle Interaction (VI) controls.

The guide has six further objectives (see Figure 1):

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

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WBS Objective 1: Project Management – Results and Work packages

For Project Charter:
Company Standards relevant to Vehicle Interaction e.g. Safety Hazard Protocols for Mobile Equipment
EMESRT Vehicle Interaction Control Improvement Strategy 2020

been applied at EMESRT member operating sites. This includes the operational knowledge and experience to plan and deliver projects that improve vehicle interaction (VI) controls. These are in turn linked to work packages with starting point information that can be used to plan and deliver projects that improve vehicle interaction (VI) controls.

resource is organised around a series of work packages that are developed in the procedure

These are in turn linked to work packages with starting point information that can be used to plan and deliver projects that improve vehicle interaction (VI) controls.

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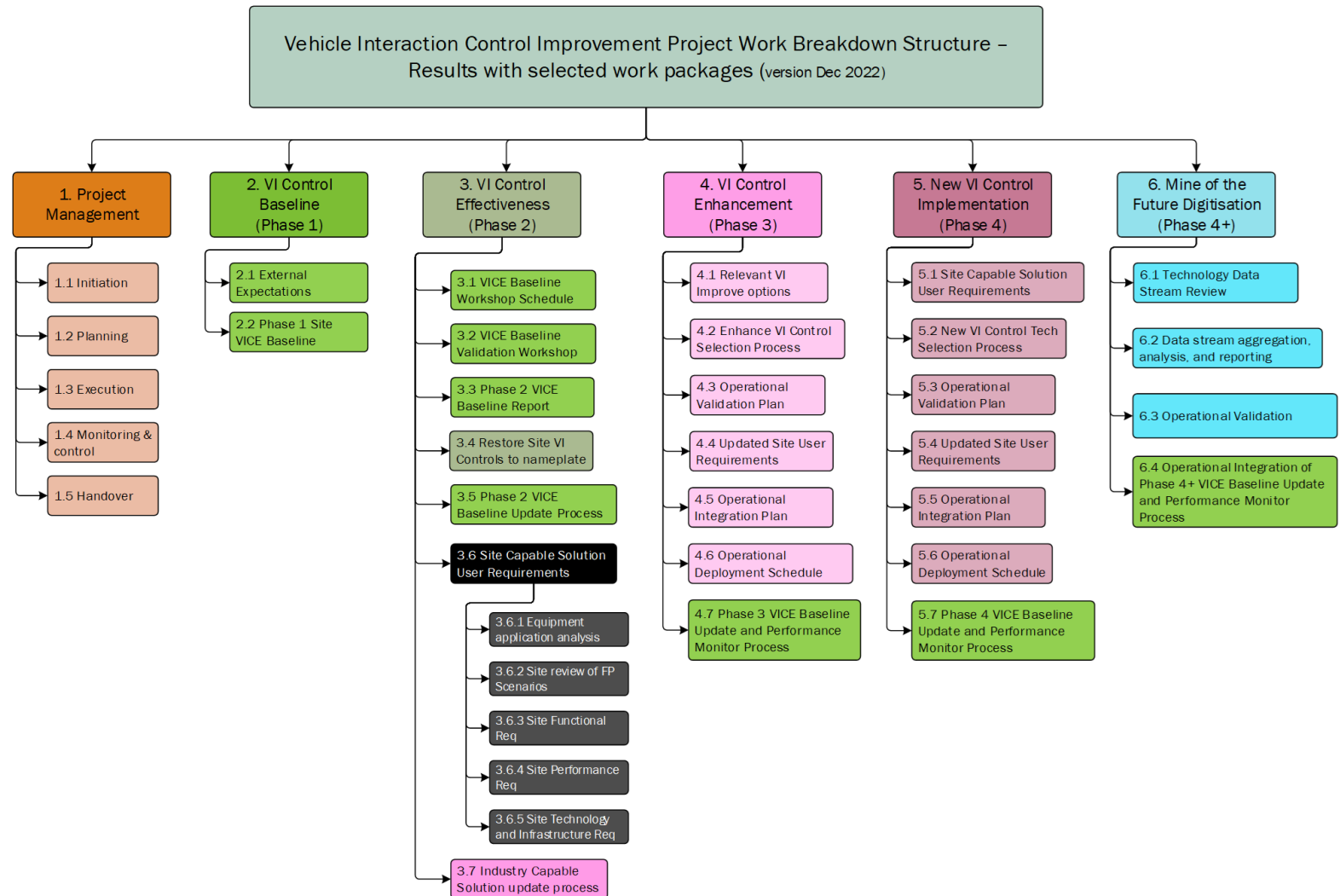
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VI Control Improvement Project – WBS for Project Managers

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*

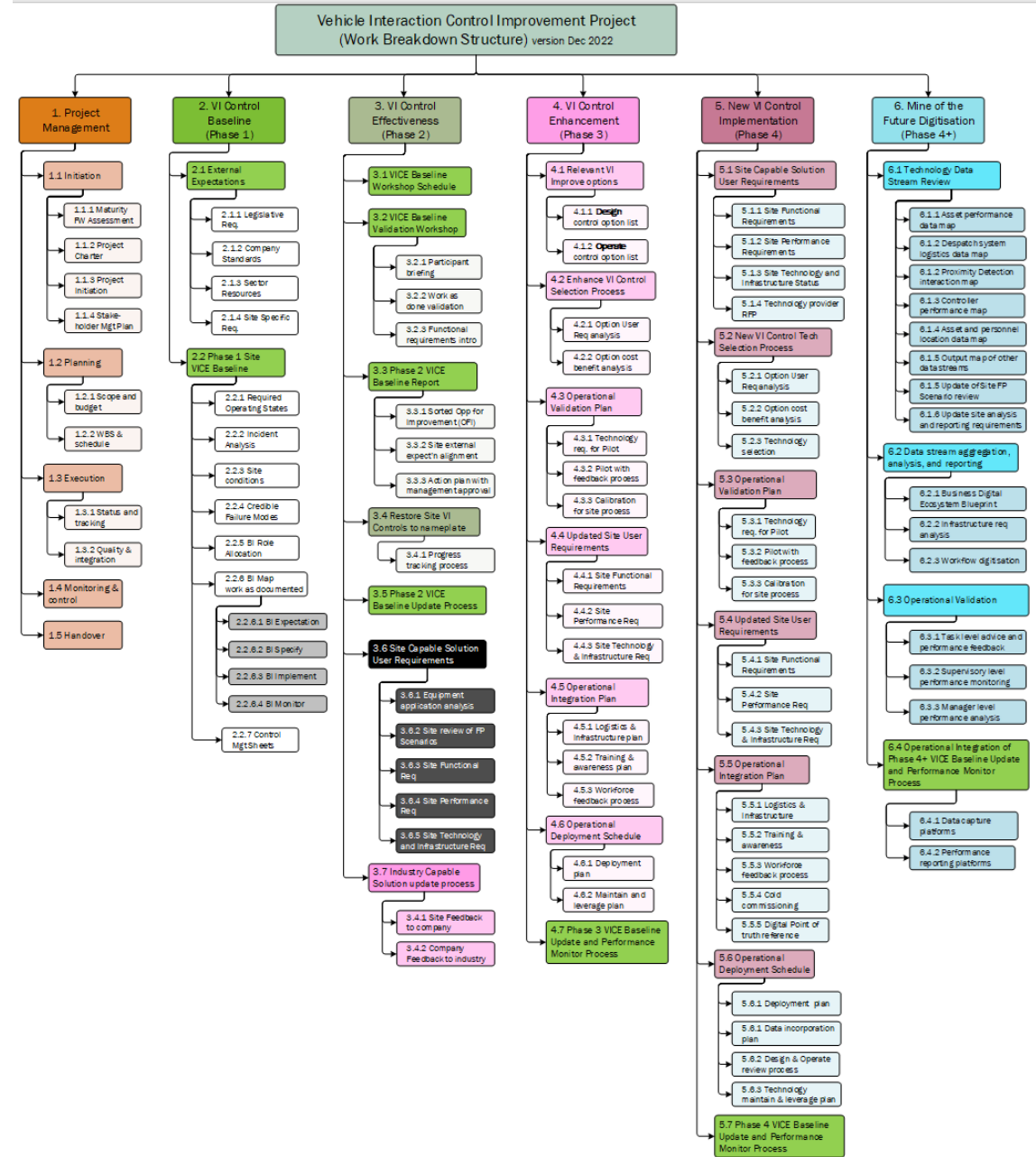


EMESRT Project Outputs - Work Breakdown Structure (WBS) Example

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

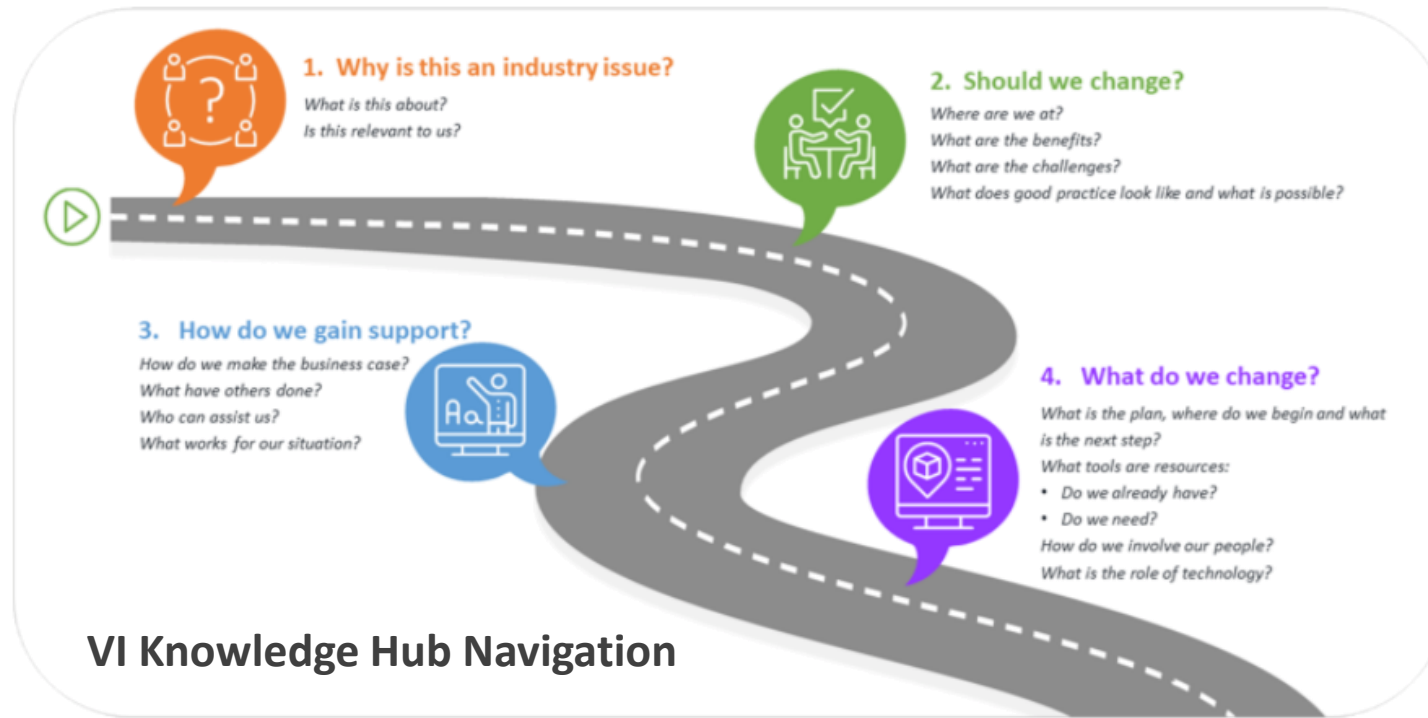
This example WBS has these objectives:

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



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

