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Current Status & The Future of Critical Control Management in the Australian Resource Industry

Minerals Industry Safety & Health Centre

Sustainable Minerals Institute

Brett Garland

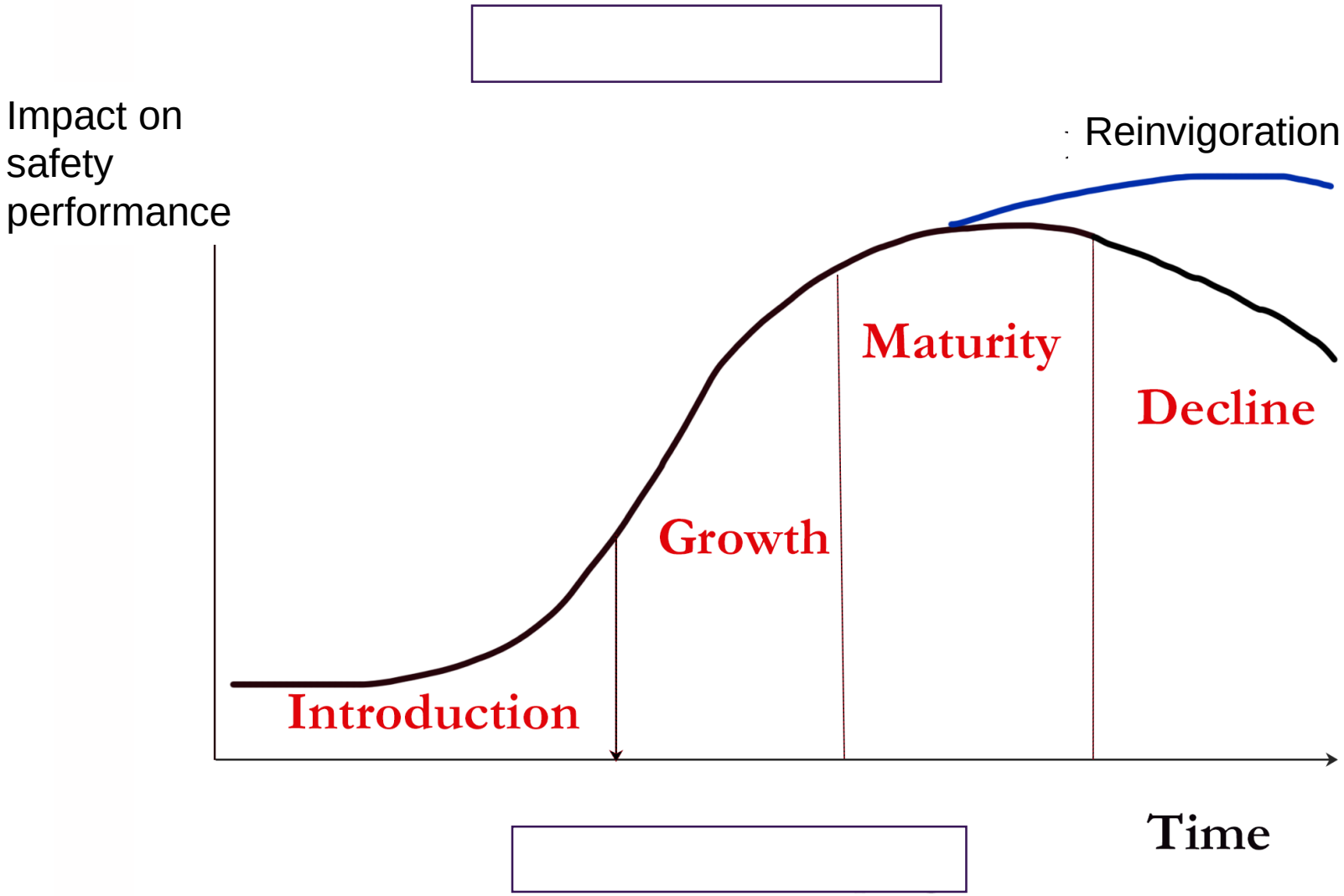
Summary

Most of the large resource companies are implementing the Critical Control Management processes consistent with ICMM

(The International Council on Mining and Metals) approach

- BHP
- Anglo American
- Rio Tinto
- Glencore
- Peabody
- Sandvik
- Hanson Construction Materials
- Additionally – **Oil and Gas, Construction and Regulators**

Safety Innovation Lifecycle



9 Steps where

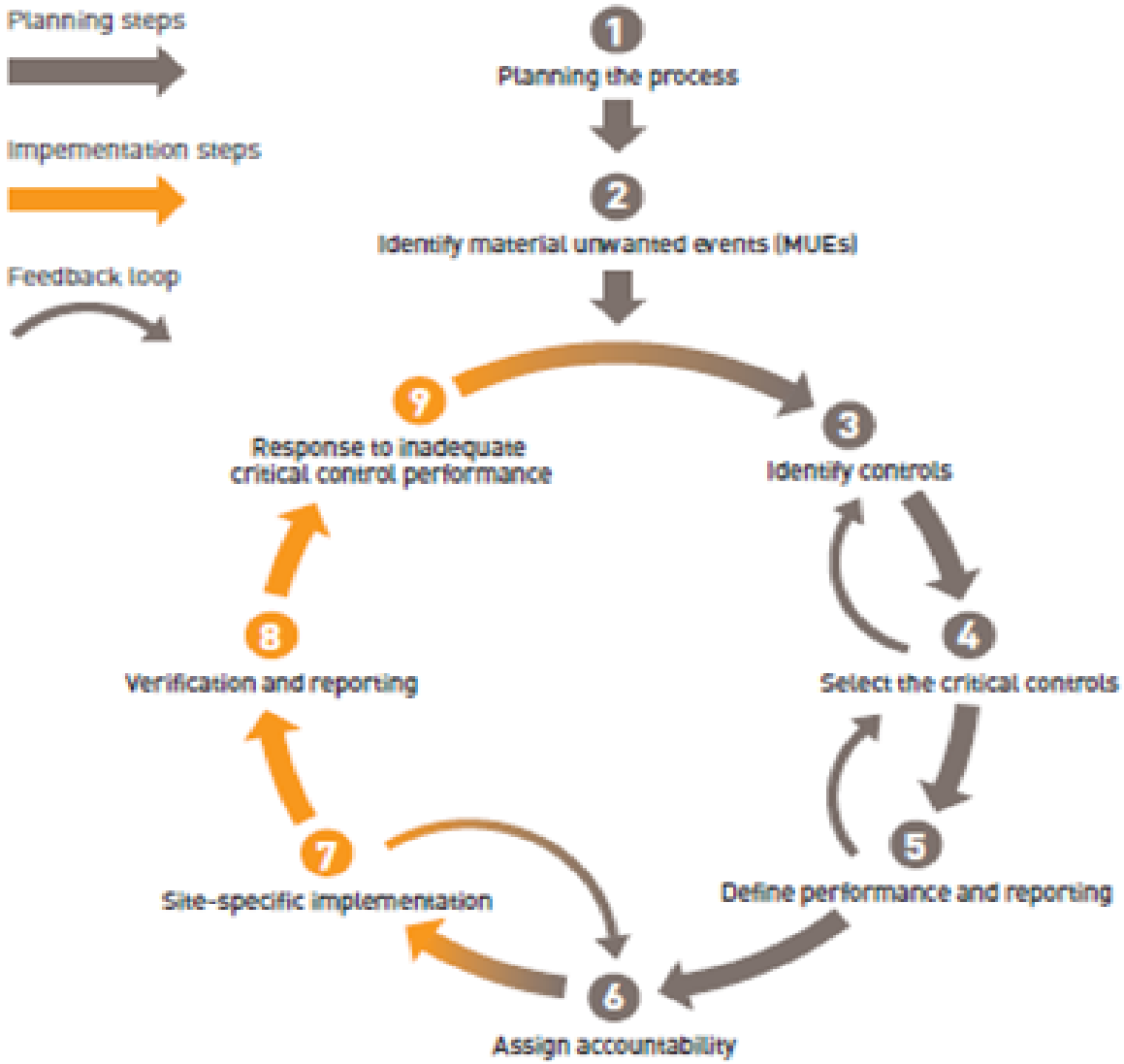
Success

&

Challenges

are happening

Figure 1: The critical control management process



Planning the process

Different starting points

Improving verification and reporting

Identifying controls and selecting correct critical controls

Assigning accountabilities

Factors affecting rate of progress

Resources applied

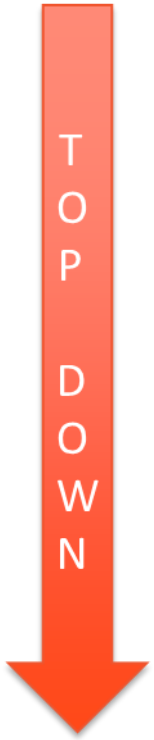
MUEs selected

Effort getting content correct vs effort getting system working and effective

Currently

- ✓ Full cycle needed to have CCM embedded – need good content and system
- ✓ Some are reviewing content and some are designing system

Planning the process



Regions or companies are doing bow-tie and selecting the controls

Challenges

- Embedding the understanding
- Getting buy-in at front line
- Producing controls and verification that match site specific risks

Each site does bow-tie and feed up to corporate

- Struggles to produce good consistent quality for
  - Bowties
  - Control Selection and Specification
  - Verification materials

Selecting Material Unwanted Events MUEs

ICMM definition

An wanted event where the potential or real consequence exceeds a threshold defined by the company as warranting the highest level of attention

Key Actions

Understand major hazards and identify potential MUEs.

Apply selection criteria to MUEs with a focus on the consequences – maximum reasonable consequences

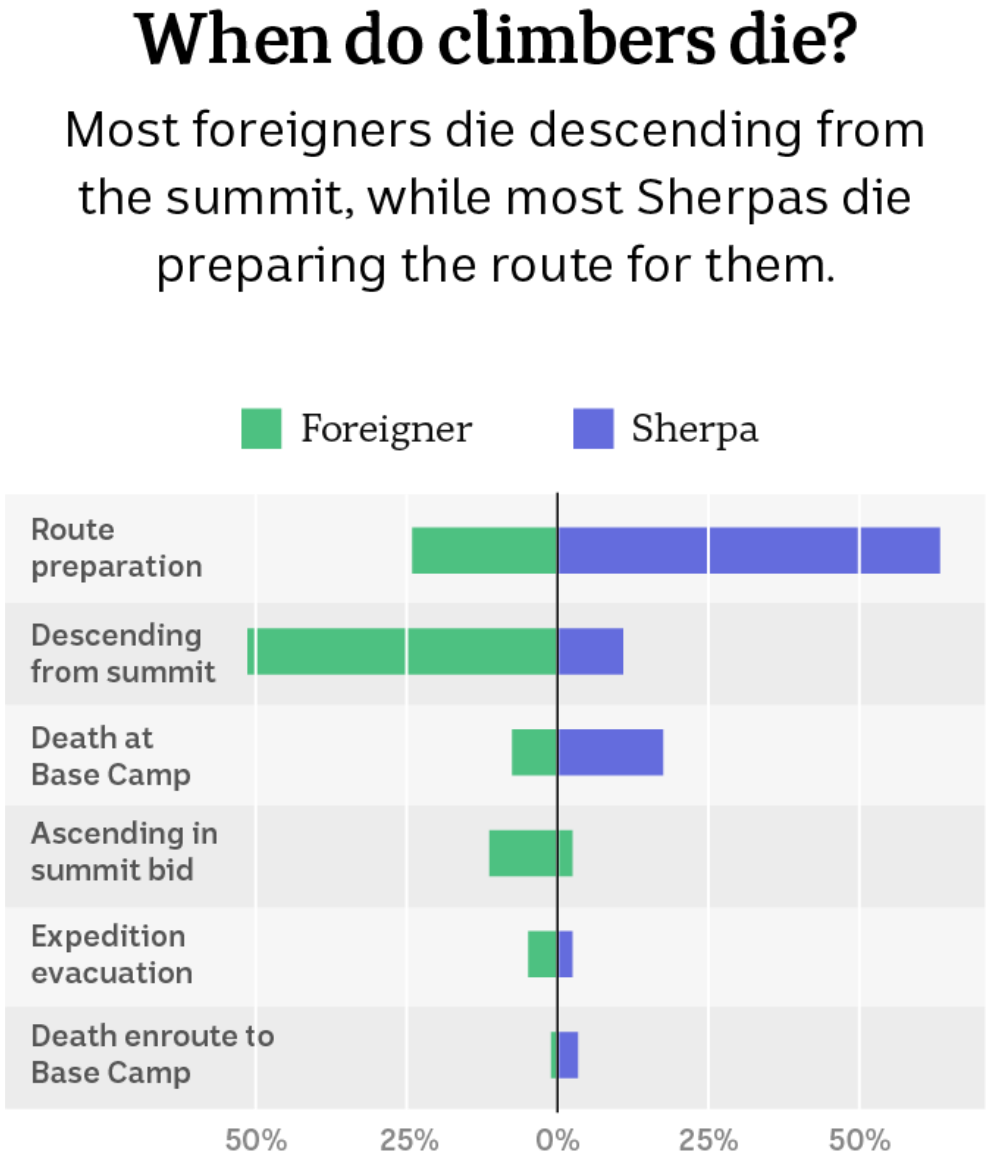
Identify design opportunities to address the hazard, reducing the potential consequences and eliminating the MUE from the CCM process.

Describe the identified MUE, including the relevant hazard, mechanism of release and nature of the consequences

Examples of Mining and Metals MUEs
Aviation
Underground ground control
Underground fire/explosion
Heavy mining equipment
Dropped objects
Pressurized systems
Confined spaces
Inrush/inundations
Explosives
Highwall stability
Flammable gas
Light vehicles
Work at height
Electricity
Hazardous materials

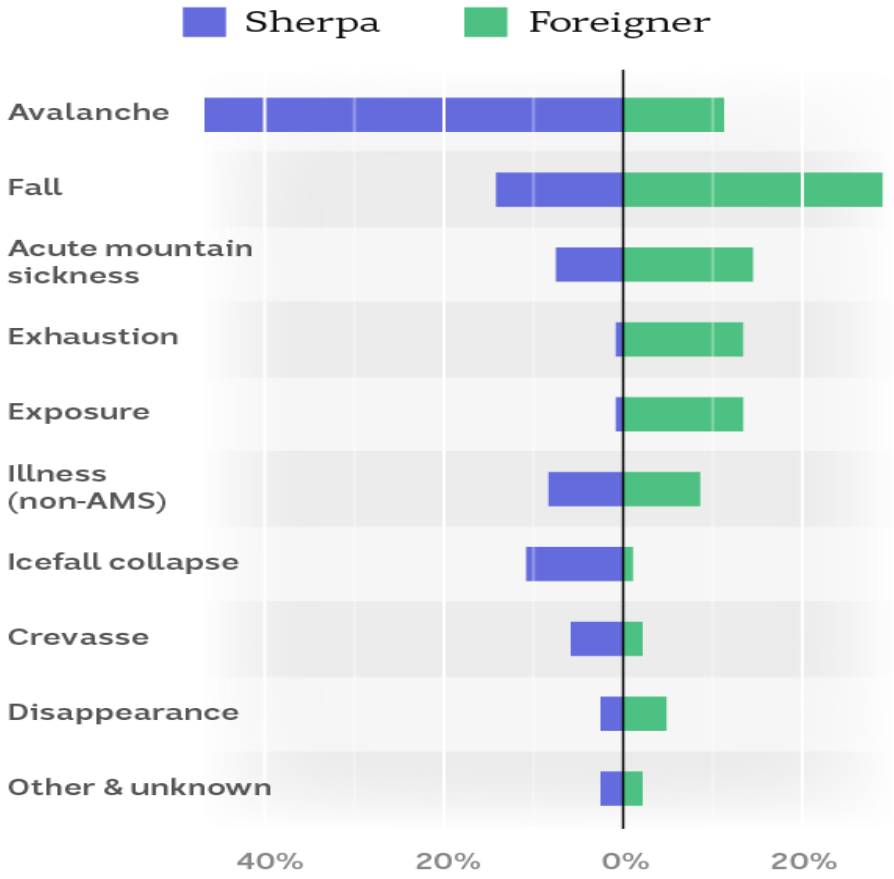
Case study

Understand the MUE



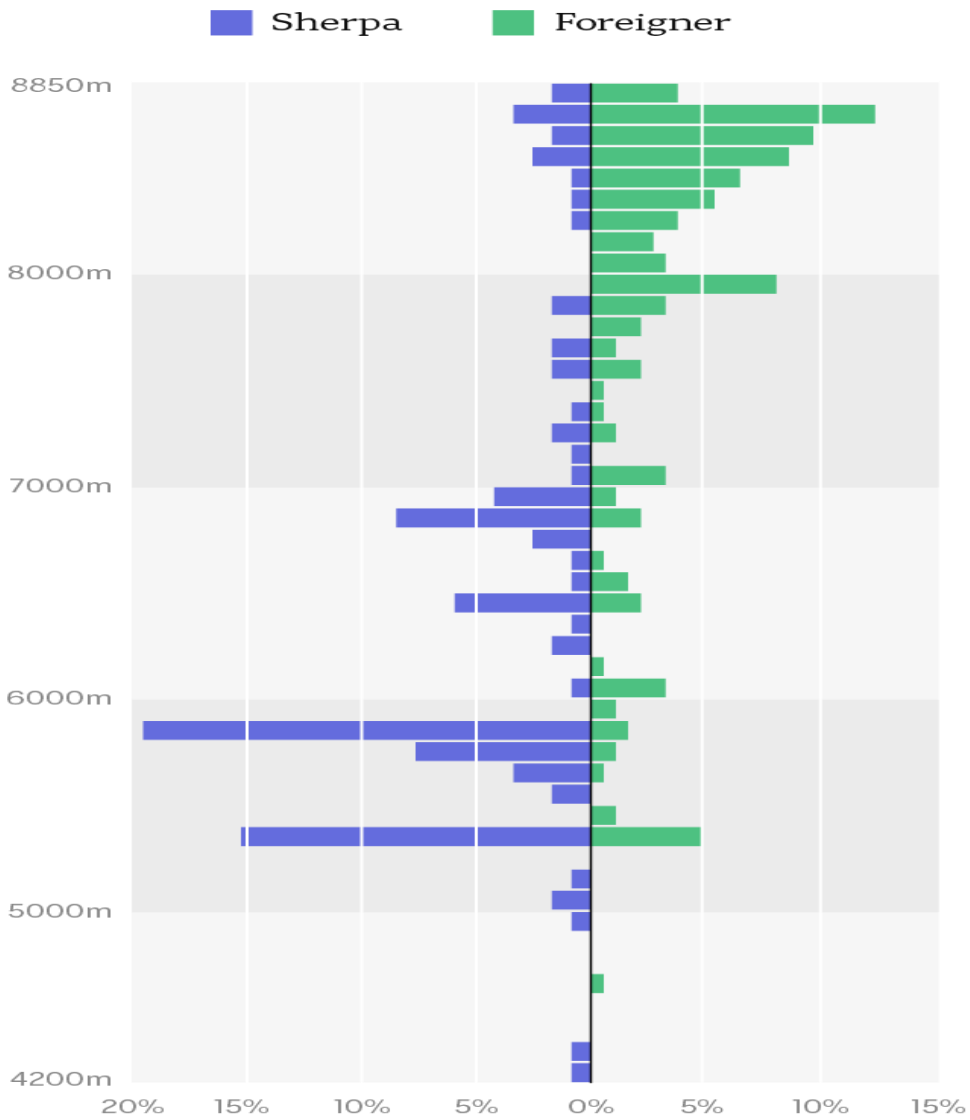
How do climbers die?

Falls kill the most foreigners on Everest, while most Sherpas have been killed by avalanches.



Deadliest altitudes

Foreigners are most likely to die at altitudes above 8000m, while the deadliest altitudes for Sherpas are between 5300m and 5800m.

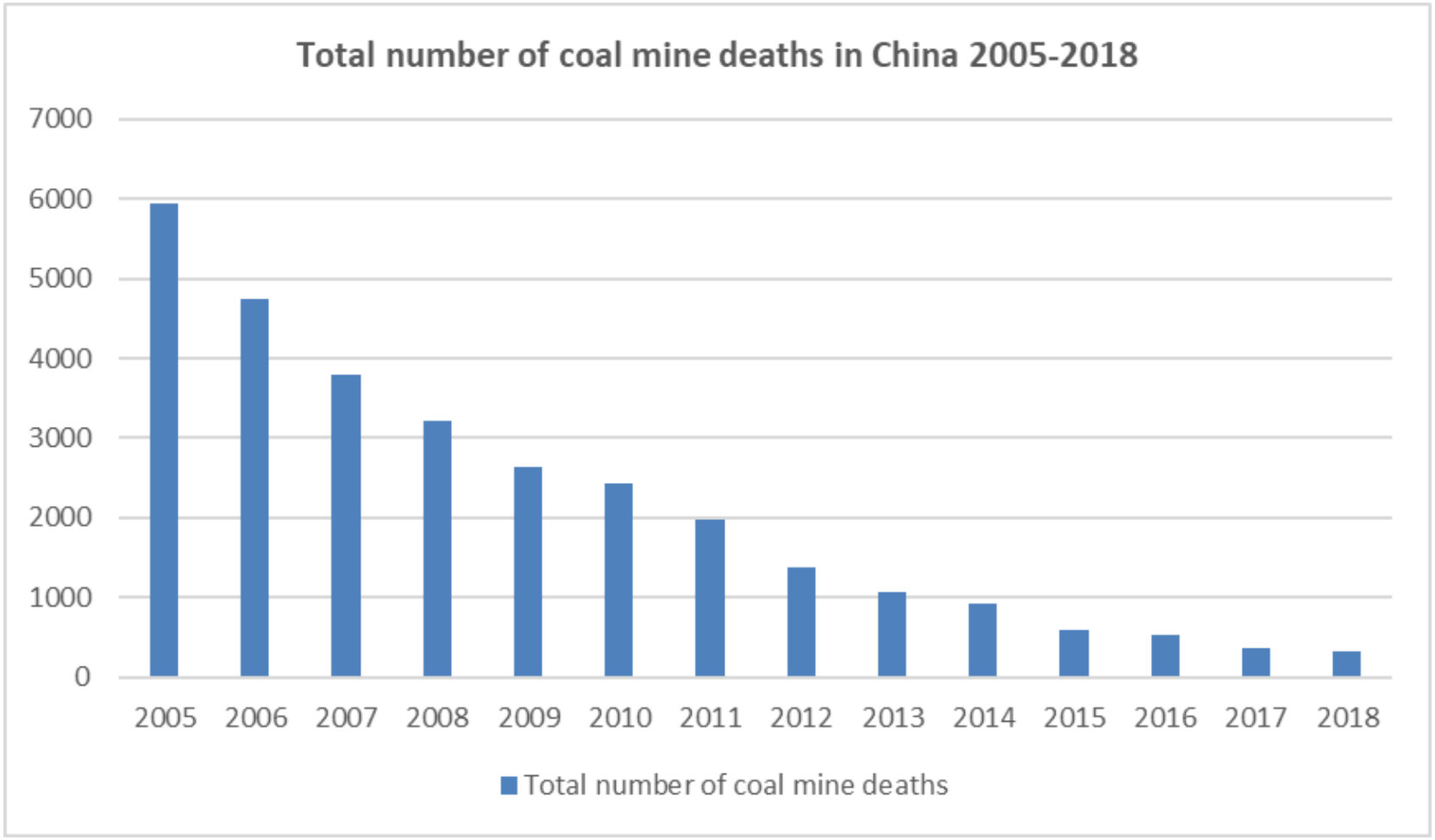


Selecting MUE challenges

- Criteria for MUE
  - Single fatality (eg Rio Tinto, Downer, Sandvik)
  - Multiple fatality (eg BHP, Glencore)
  - Variation between site and corporate requirements – need to do both?
  - Problems with health and well-being risks

- Documenting the scope
  - clarifies what is included and excluded
  - needs to be written down
  - checks work covers all locations, equipment, people, activities, scenarios
  - highlights overlapping elements

Indicative Graph of Safety Performance



Using Bowties

Bowtie challenges

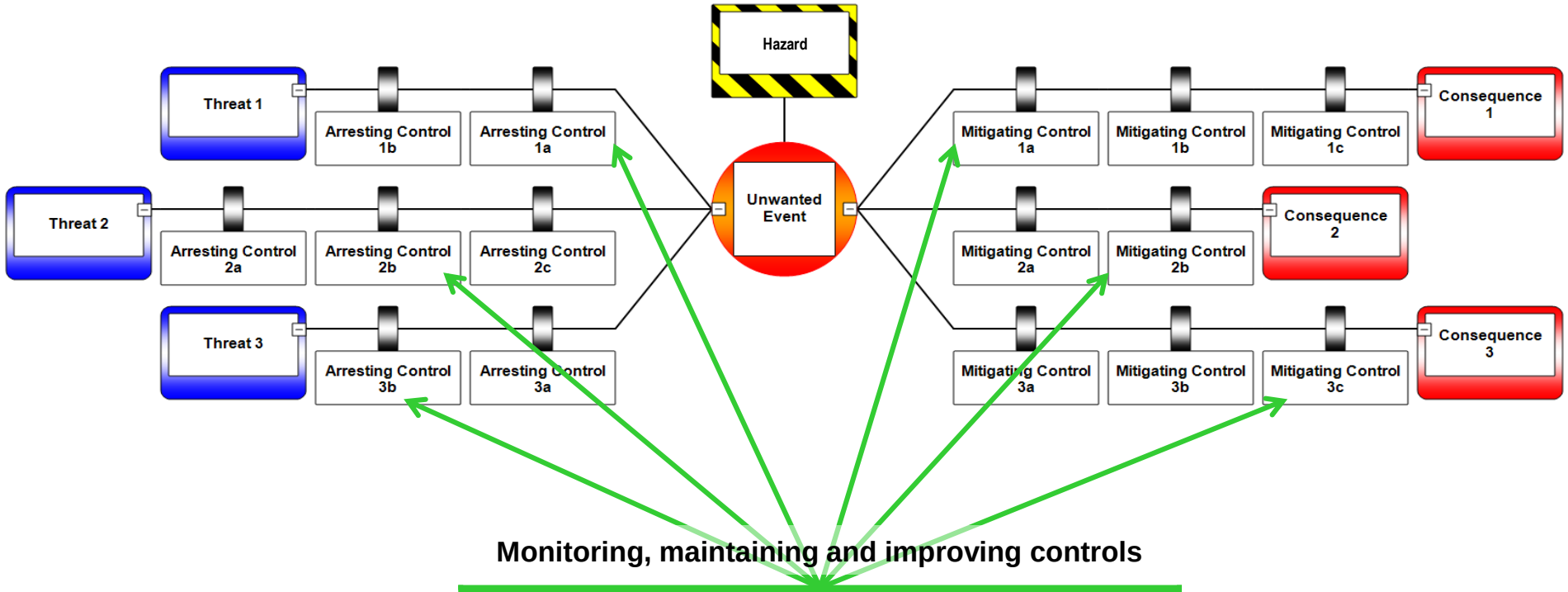
- Different levels of bowties – high level corporate to site specific
- Guidance does vary
- Right content and correct level of detail

Good hazard control bowties for "front-line" workers or Corporate tool?

- Have I got the right hazard – the inherent risk source that has the potential to cause harm
- Have I identified all the threats – the mechanisms that can release the hazard
- Is the knot the initial point where control is lost?
- Have I identified both primary and secondary fatalities
- Are the controls action or object that of itself directly arrests the event or consequence? Are they it specifiable, measurable and auditable?
- Have I got sufficient controls to adequately address all threats and consequence over an entire event sequence?
- Is the bowtie understandable, precise, concise, and comprehensive?

Bow tie representation of risk and control

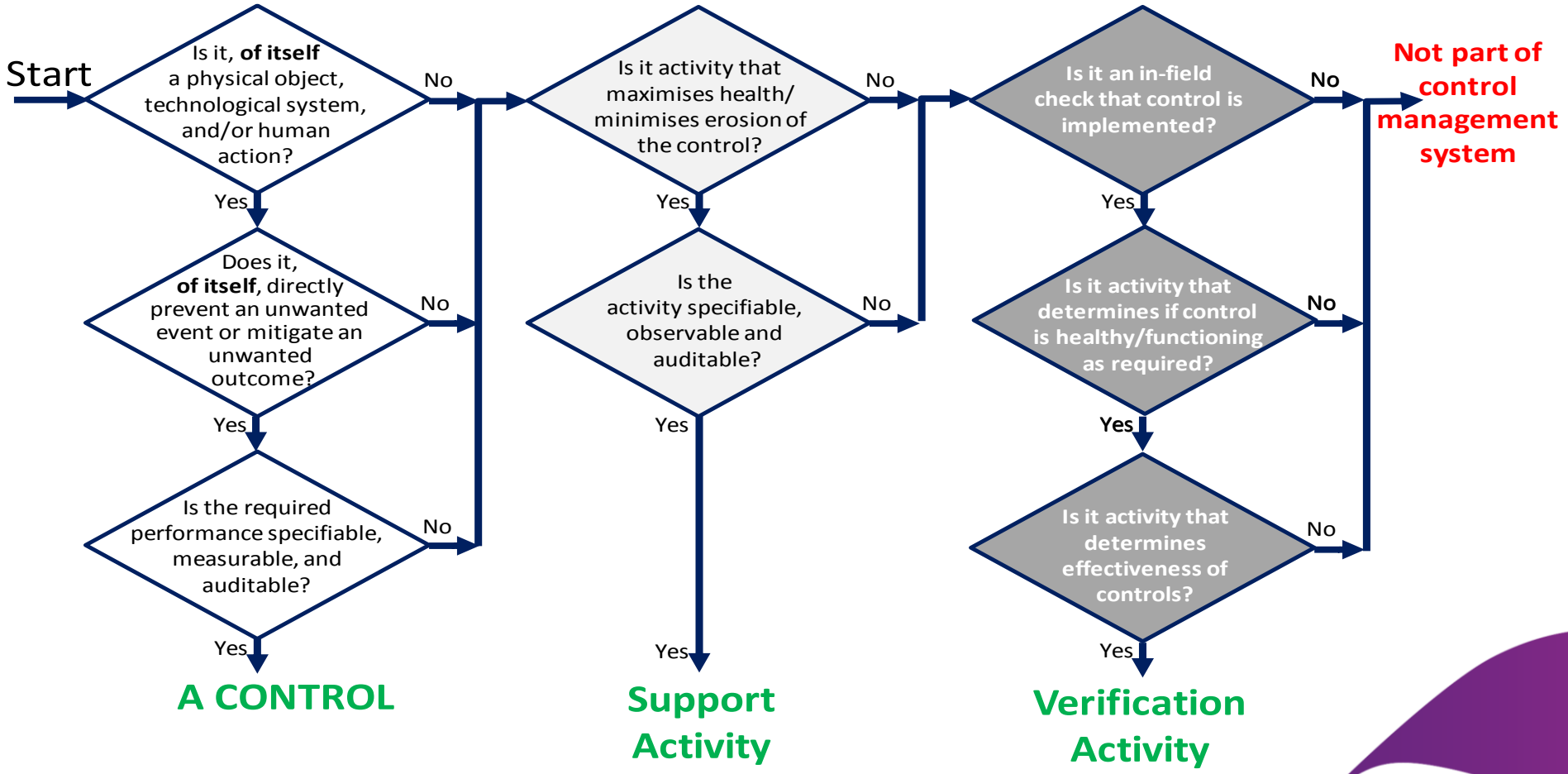
Risk management strategies = Assuring effective control over time

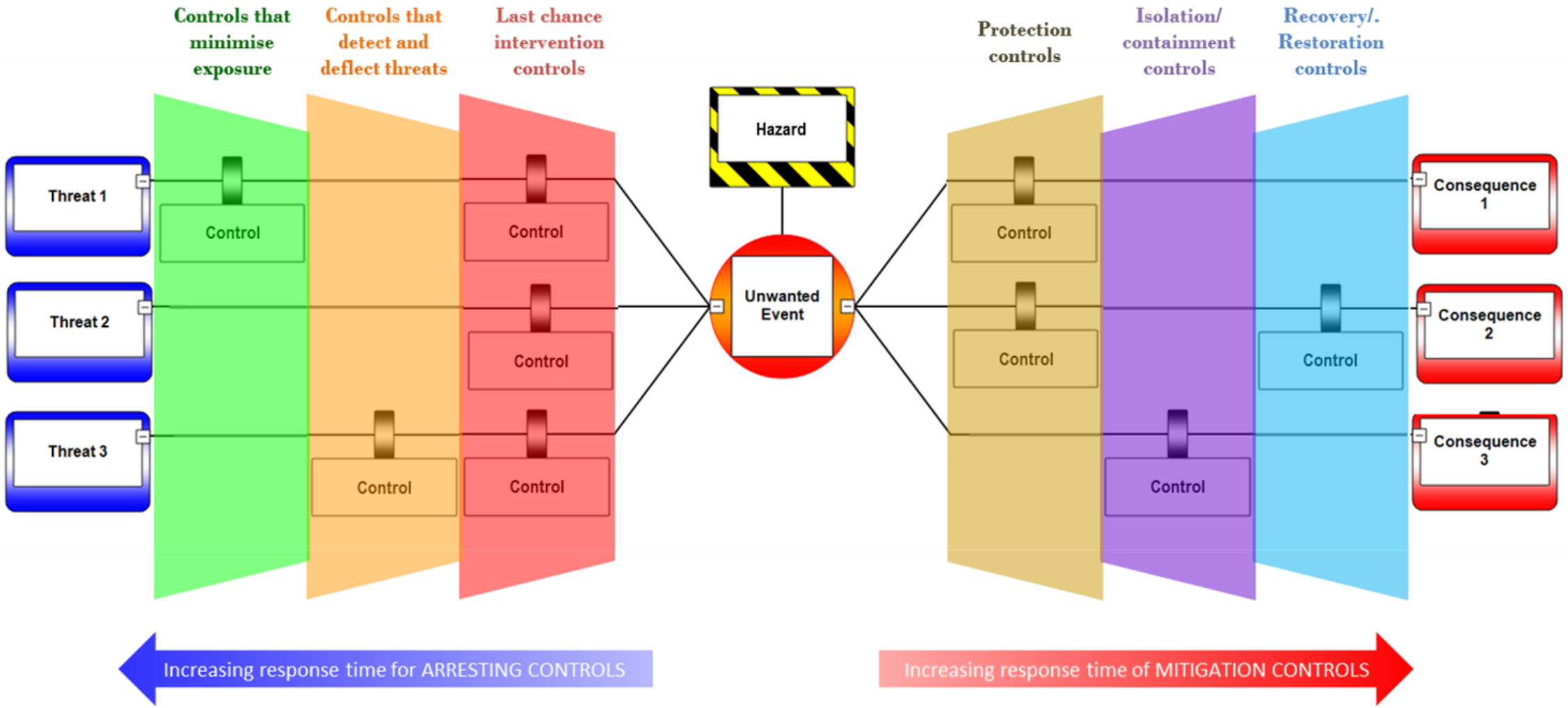


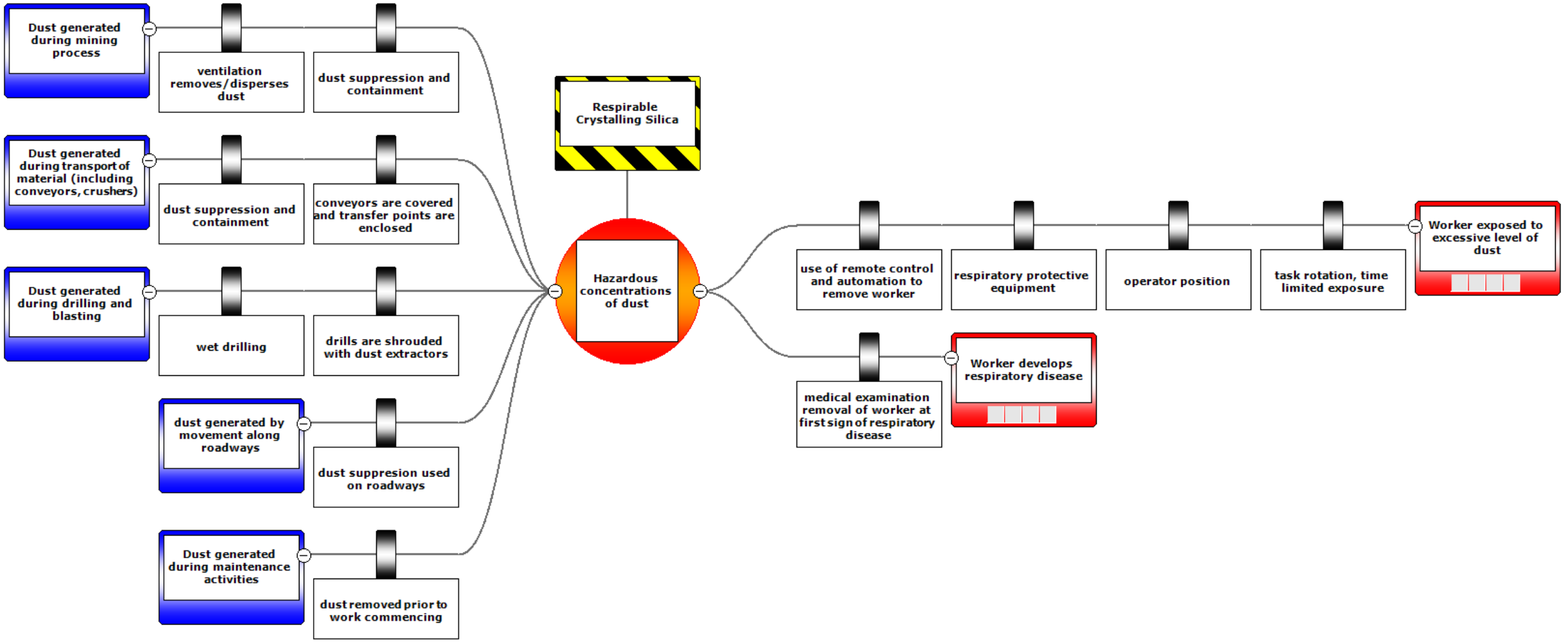
Monitoring, maintaining and improving controls

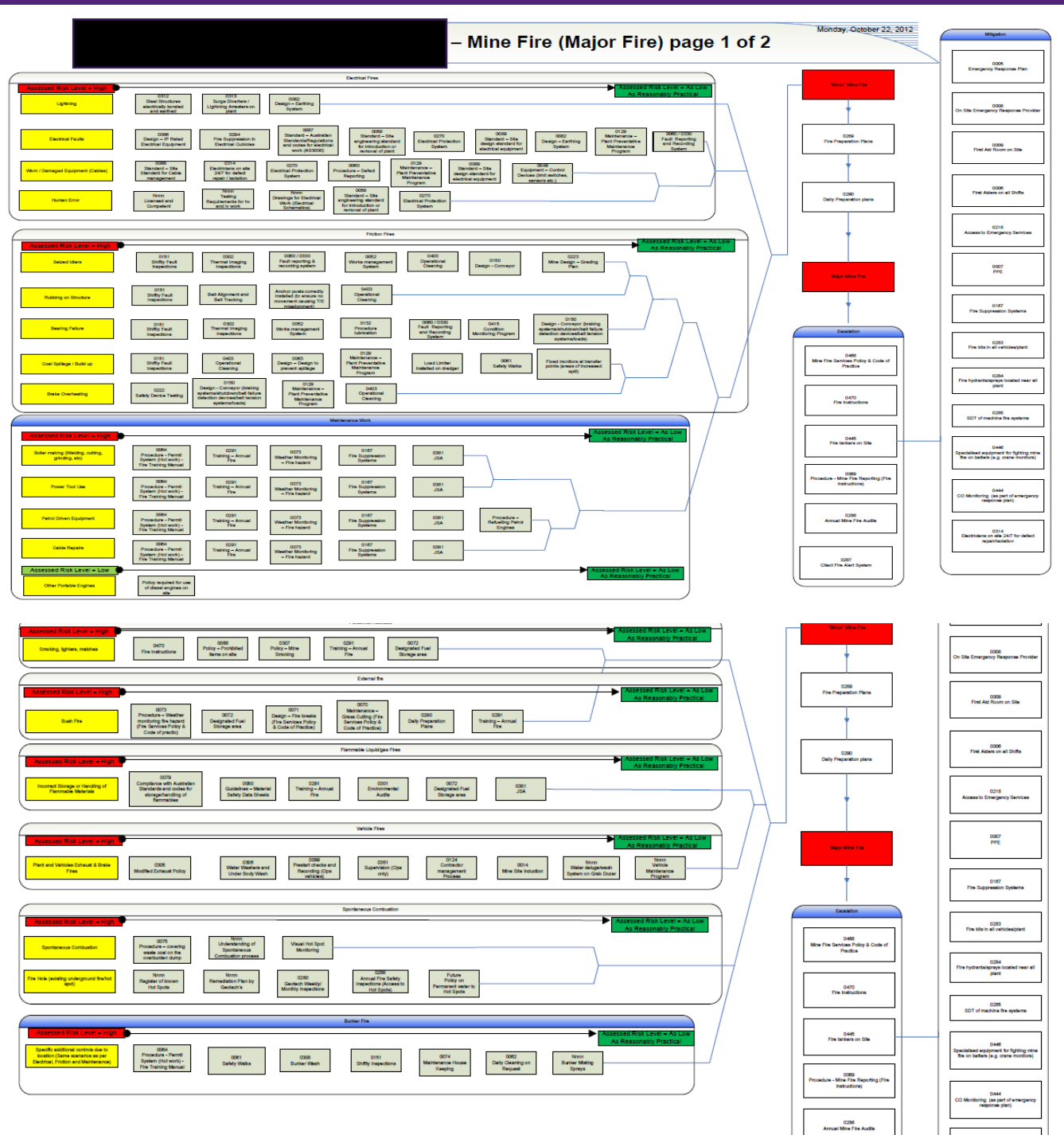
CONTROL ASSURANCE MANAGEMENT SYSTEM (CAMS)
Operations activities
Maintenance activities
Engineering activities
Management activities

Control sorting exercise




Controls that minimise exposure
Controls that detect and deflect threats
Last chance intervention controls
Protection controls
Isolation/ containment controls
Recovery/. Restoration controls
Hazard
Threat 1
Threat 2
Threat 3
Control
Control
Control
Control
Control
Control
Control
Control
Control
Unwanted Event
Consequence 1
Consequence 2
Consequence 3
Increasing response time for ARRESTING CONTROLS
Increasing response time of MITIGATION CONTROLS


Dust generated during mining process
ventilation removes/disperses dust
dust suppression and containment
Dust generated during transport of material (including conveyors, crushers)
dust suppression and containment
conveyors are covered and transfer points are enclosed
Dust generated during drilling and blasting
wet drilling
drills are shrouded with dust extractors
dust generated by movement along roadways
dust suppresion used on roadways
Dust generated during maintenance activities
dust removed prior to work commencing
Respirable Crystalling Silica
Hazardous concentrations of dust
use of remote control and automation to remove worker
respiratory protective equipment
operator position
task rotation, time limited exposure
Worker exposed to excessive level of dust
medical examination removal of worker at first sign of respiratory disease
Worker develops respiratory disease


[redacted] – Mine Fire (Major Fire) page 1 of 2
Monday, October 22, 2012
Electrical Fires
Assessed Risk Level = High
Assessed Risk Level = As Low As Reasonably Practical
Lightning
Electrical Faults
Worn / Damaged Equipment (Cables)
Human Error
Friction Fires
Seized Idlers
Rubbing on Structure
Bearing Failure
Coal Spillage / Build up
Brake Overheating
Maintenance Work
Boiler making (Welding, cutting, grinding, etc)
Power Tool Use
Petrol Driven Equipment
Cable Repairs
Assessed Risk Level = Low
Other Portable Engines
Smoking, lighters, matches
External fire
Bush Fire
Flammable Liquid/gas Fires
Incorrect Storage or Handling of Flammable Materials
Vehicle Fires
Plant and Vehicles Exhaust & Brake Fires
Spontaneous Combustion
Fire Hole (existing underground firefloor spot)
Bunker Fire
Specific additional controls due to location (Same scenarios as per Electrical, Friction and Maintenance)
"Minor" Mine Fire
Fire Preparation Plans
Daily Preparation plans
Major Mine Fire
Escalation
Mine Fire Services Policy & Code of Practice
Fire Instructions
Fire tankers on Site
Procedure - Mine Fire Reporting (Fire Instructions)
Annual Mine Fire Audits
Mitigation
Emergency Response Plan
On Site Emergency Response Provider
First Aid Room on Site
First Aiders on all Shifts
Access to Emergency Services
PPE
Fire Suppression Systems
Fire kits in all vehicles/plant
Fire hydrants/sprays located near all plant
SDT of machine fire systems
Specialised equipment for fighting mine fire on bellets (e.g. crane monitors)
CO Monitoring (as part of emergency response plan)
Electricians on site 24/7 for defect repair/isolation

Critical Controls ??

What is a critical control

How do we select it

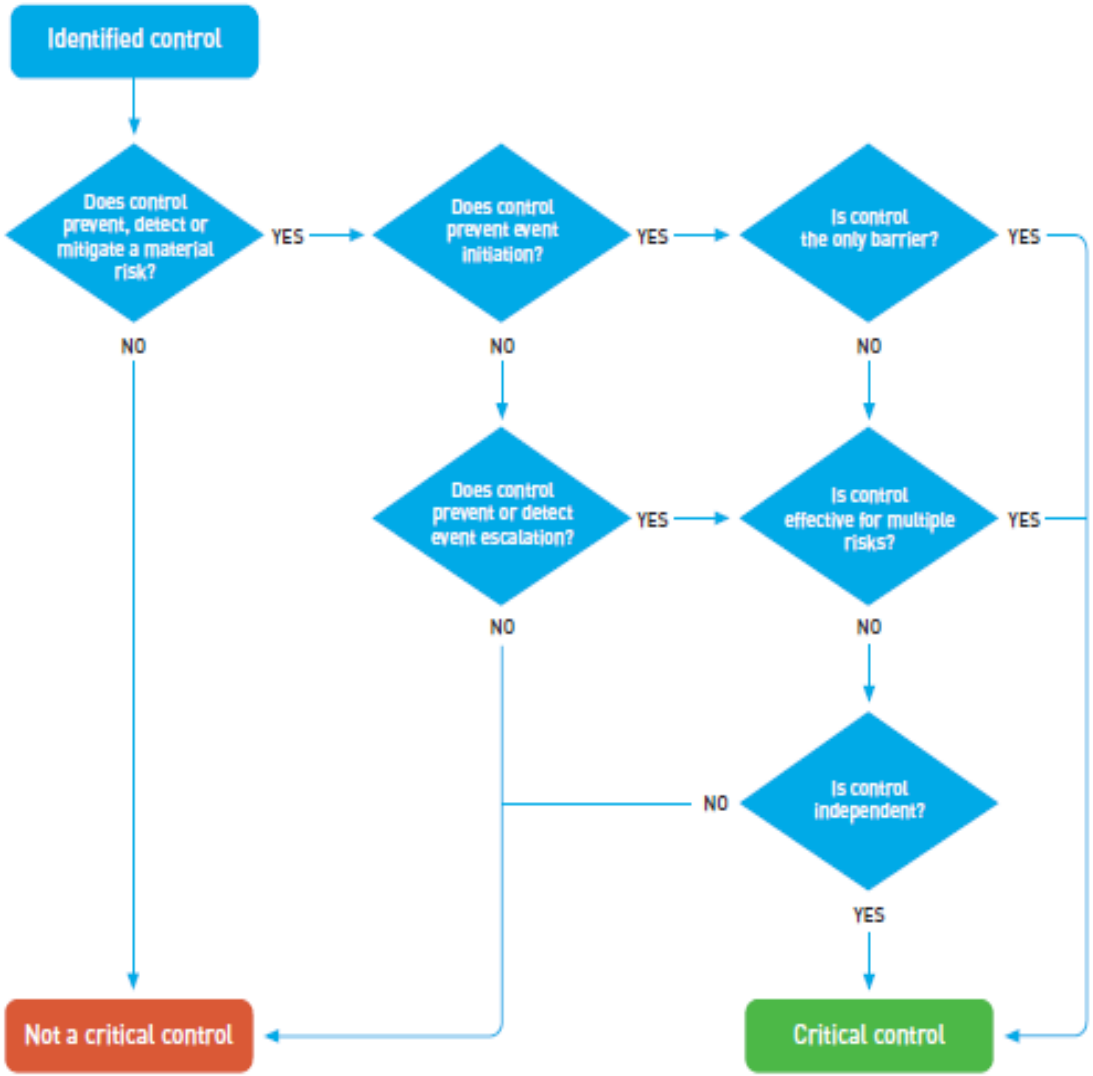
Some using ICMM filter – others have modified it

Rule of thumb eg

4 – 6 critical controls per bow-tie

1 critical control per threat line

Figure 4: BHP Billiton critical control decision tree



Inadequate critical control performance

Define

- Adequate vs inadequate
- Required response

Identify

- Monitoring
- Verification
- Incident investigation

Challenge - Deciphering issues of control ineffectiveness

- Improving inherent control activity
- Improving control support to better address erosion factors
- Benefits and limitations of analysis

Failure of controls

In other words:

How do you know the control is operating as designed?

How can you assess this?

How do you know the control is effective?

How can you assess this?

What can prevent the control from being effective?

Can you measure this deviation?

Performance requirements

- Objective performance requirements
- Triggers for stopping or changing operations
- Verification and reporting requirements

Done with varying degrees of rigour! If not done well

- Varying understanding of what is an effective control eg vehicle separation distance, stopping/yielding at intersections
- Clear triggers or people will not stop.

“Stop” trigger – stop when it isn’t safe

“Go” trigger – only proceed when you have verified it is safe to do so

Verification and reporting challenges

CCRM – check objects (relatively easy) and actions (not so easy)

Leading practice is focusing on:

- Right people:
  - doing the verifications in a timely manner
  - understanding the fundamentals of CCRM
  - understanding the control being verified so they can do a quality job

- Discussions that seek to understand:
  - when the control action and monitoring processes work well
  - when they don’t
  - what might be required to further enhance the performance of the control

Risk normalisation

Site Specific Implementation – Front-line challenges

- fundamentals are understood as to why CCRM is being done so it doesn't become a tick and flick process
- where appropriate it replaces or complements rather than duplicates current work. Most of what comes out of CCRM is already buried within existing plans, procedures, inspections, processes etc.
- this part of the program is appropriately measured and reported
- Checklists
- Focus on supervisors
- Re-structuring of safety conversations

Summary

- Reach the front-line people – bring people with you and provide top-down support
- Leverage technology for data acquisition and analysis
- Multiple layers of assurance and verification
- CCRM is a tool – retain focus on culture and systems
- Be patient

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Thank you

Brett Garland - Director
Minerals Industry Safety and Health Centre
Sustainable Minerals Institute
b.garland@uq.edu.au
+61 7 3346 4037
+61 418 199 067