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Critical Risk Management Workshop

Christian Young – CEO

Objective

- Focus on the concepts of Critical Risk Management and Critical Controls
- High Level and simple
- Ask lots of questions

Introductions

- Name
- Role
- First Job

About Me

- 25 years Safety in Mining & Oil and Gas in Australia

I help you save lives at work

BHP
AngloAmerican
Teck
GLENCORE
NEWCREST MINING LIMITED
OCEANAGOLD
AMPOL
fitzroy
stanmore
ANGLOGOLDASHANTI
SOUTH32
MMG
KESTRELCOAL RESOURCES
Aeris RESOURCES
YANCOAL 兖煤澳大利亚有限公司
Peabody ENERGY
sojitz
Resources Safety & Health Queensland
Ensham RESOURCES
Coronado
OZ MINERALS
Mitchell SERVICES

Objective

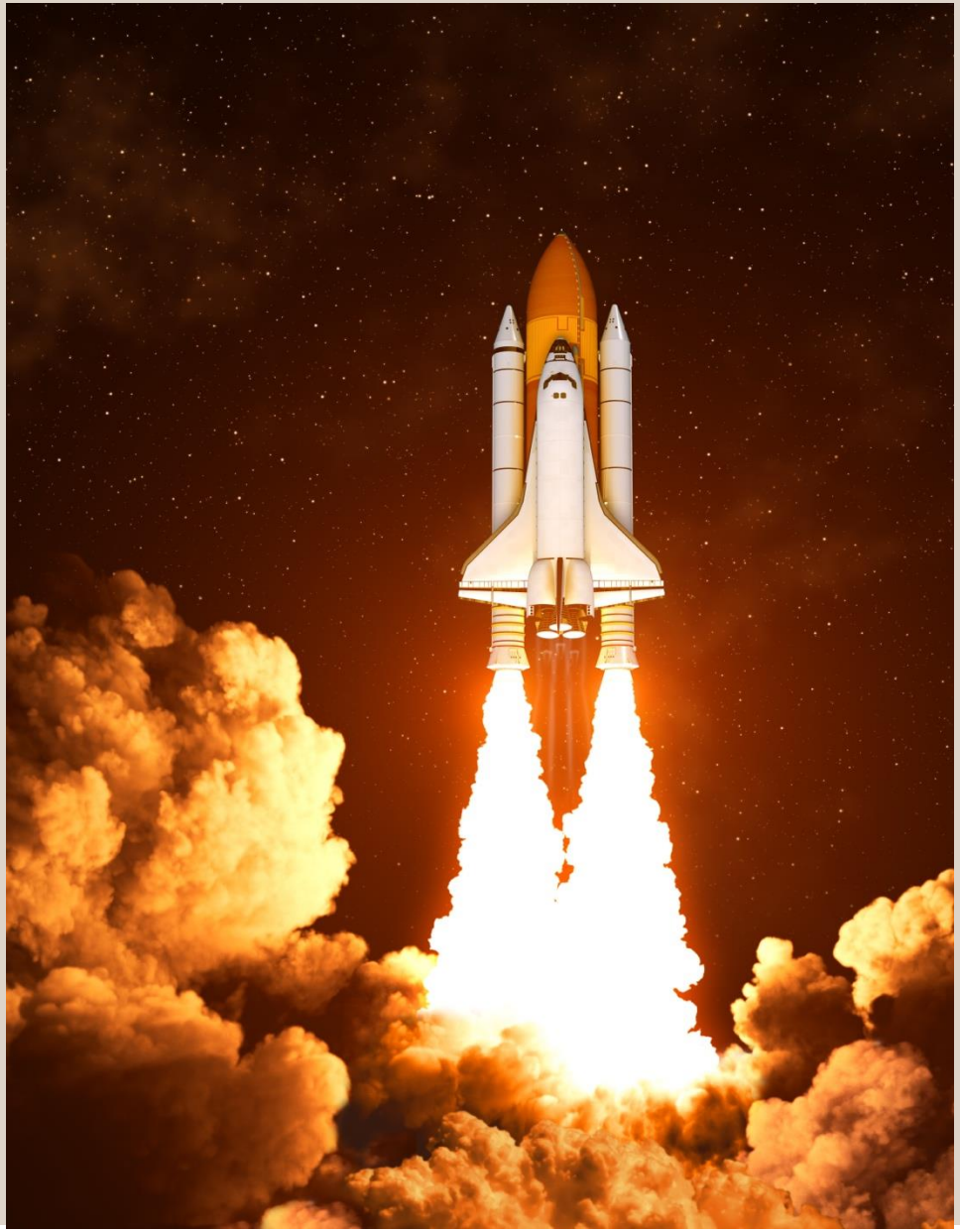
- Focus on the concepts of Critical Risk Management and Critical Controls
- High Level and simple
- Ask lots of questions
- Share and learn

Agenda

- 12.30pm: Workshop
- 3.45pm: networking

You will get a copy of the slide pack

What is a Critical Risk?



What is a Critical Risk?

Any risk whose consequence would be material to the business.

Any examples?

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Who currently has a Critical Risk Management Program?

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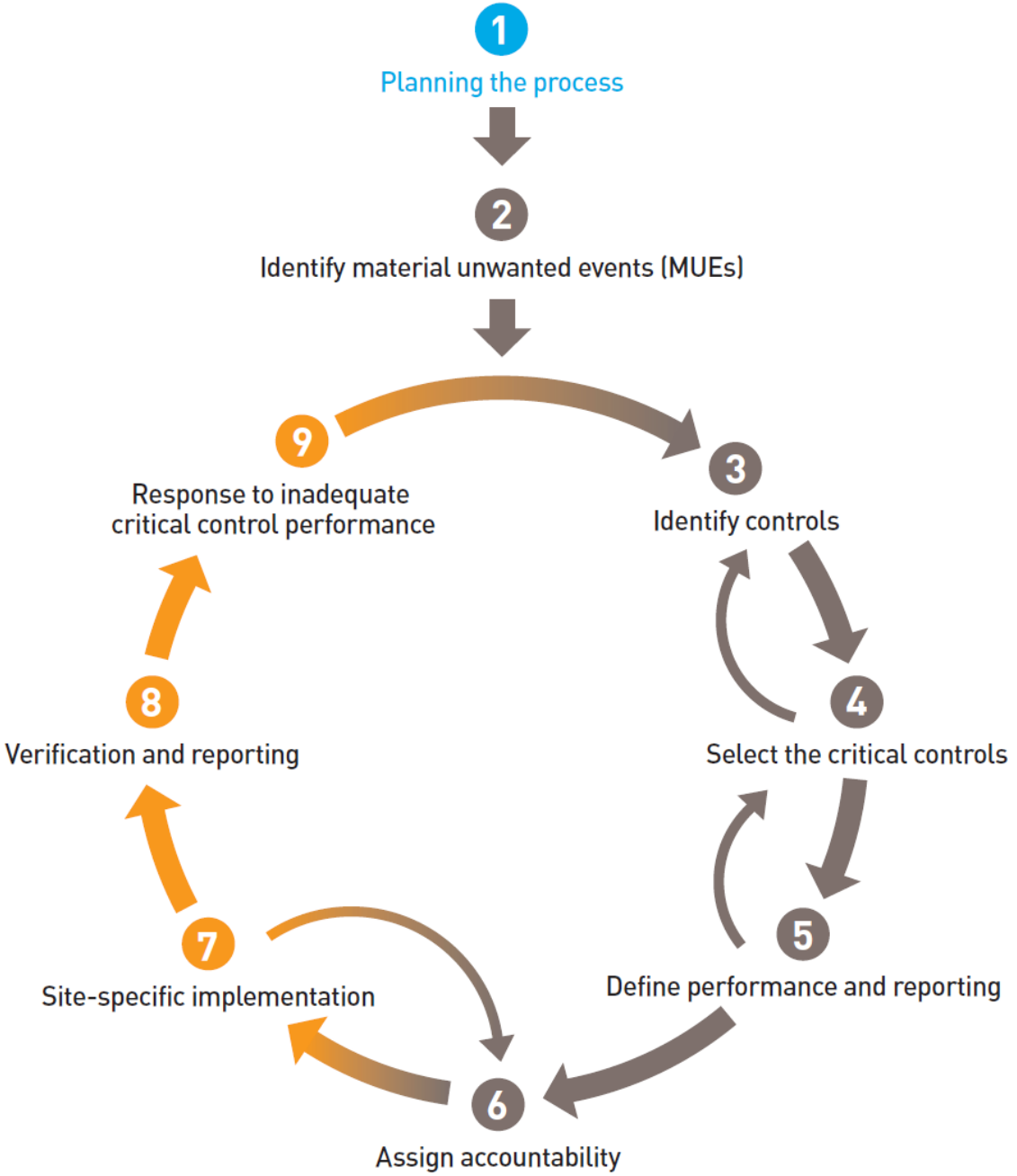
Are incidents due to a failure in risk identification or control/s?

CRM Framework

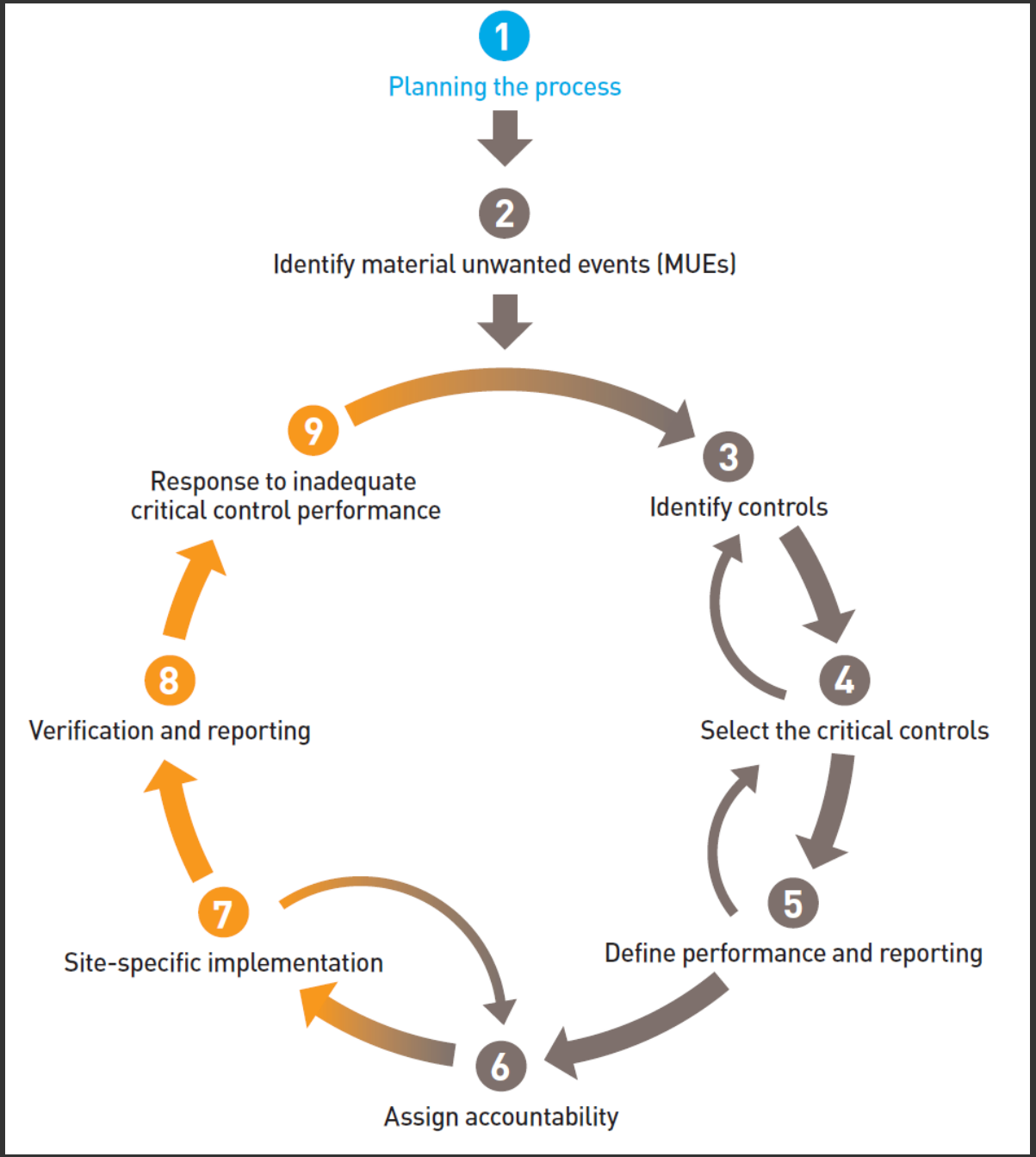


Imagine if

You are the safety manager for a commercial construction company in the UK / Europe

You have been tasked with implementing a CRM process with specific focus on managing the risk of falling from height.

CRM Planning



What do we need to consider in our plan?

Planning Considerations

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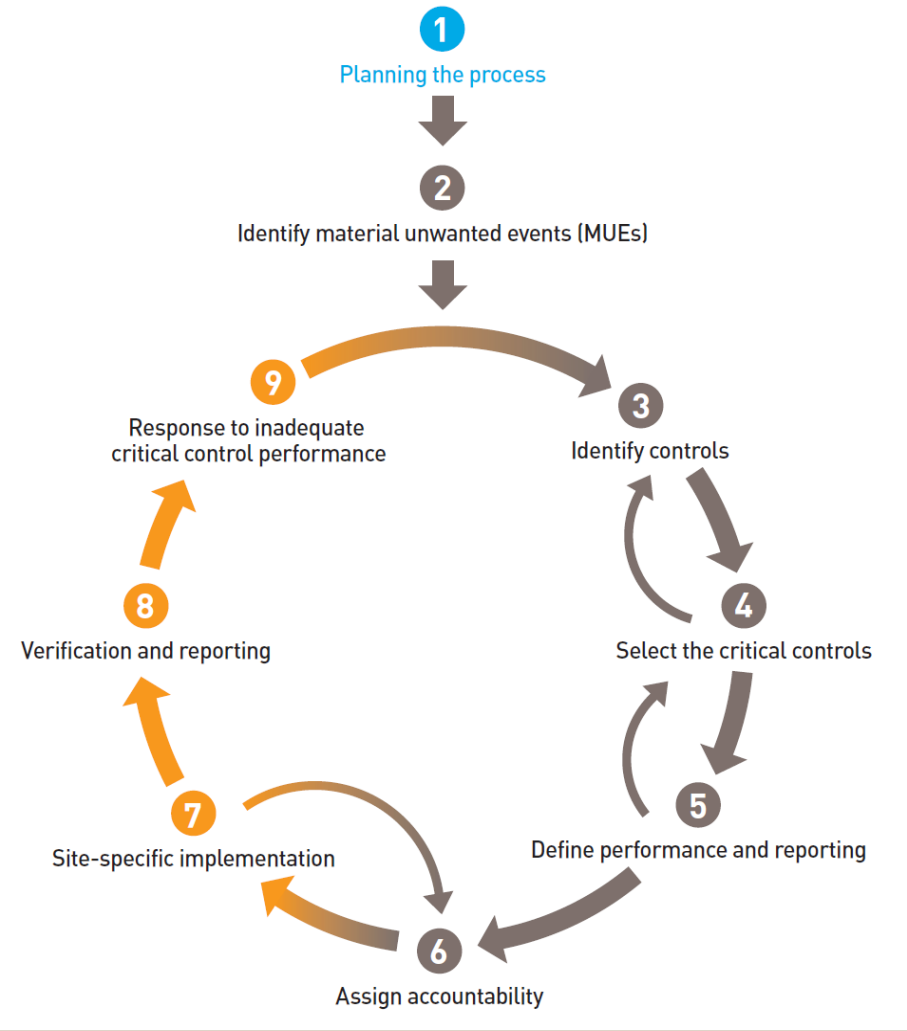
- People:
  - Managers, Board, Supervisors, Superintendents, general workforce
- Skills / Experience / Training
  - Advanced Risk Facilitation for key facilitators of the process
  - Understanding of Controls, Critical Controls, Bowties, BBRAs
- Data:
  - External requirements:
    - Group / corporate requirements, legislative requirements, industry guidance information (e.g. ICMM help guides), industry reports,
  - Business Risk data:
    - High Potential Incidents, Operational Risk Assessments, Risk Registers, Hazard Reports, Audit Reports, Bowties,
  - Operational Information:
    - Geographic Scope and Process Scope
    - Operational Hazards - Strata, Gas, Water, etc..
  - Industry Risk data:
    - Industry risk Databases (e.g. DNRM, Mirmgate, Risk Gate)
- Systems:
  - Types: Document management, Maintenance Management, Risk Management, Action Management, H&S data management, Work Planning
- Systems Integration:
  - Actions are translated into work planning activities or maintenance planning activities.
- Processes:
  - Risk Management, Action Management, Assurance, Document control, H&S Reporting, Compliance Management, Roles and Responsibilities
- Process Integration:
  - Risk and Control Owners are assigned in Roles and responsibilities, + many more
- SHMS Documentation:
  - Risk Management Procedure (describes CRM process), Action management procedure, Auditing / Assurance procedure, Roles & Responsibilities,
- Templates:
  - Broad Brush Risk Assessment, Bowtie, WRAC, Performance Standard, Critical Control Monitoring Activities
- Records:
  - BBRA, Bowties, WRACs, Performance Standard, Critical Control Monitoring Inspections,

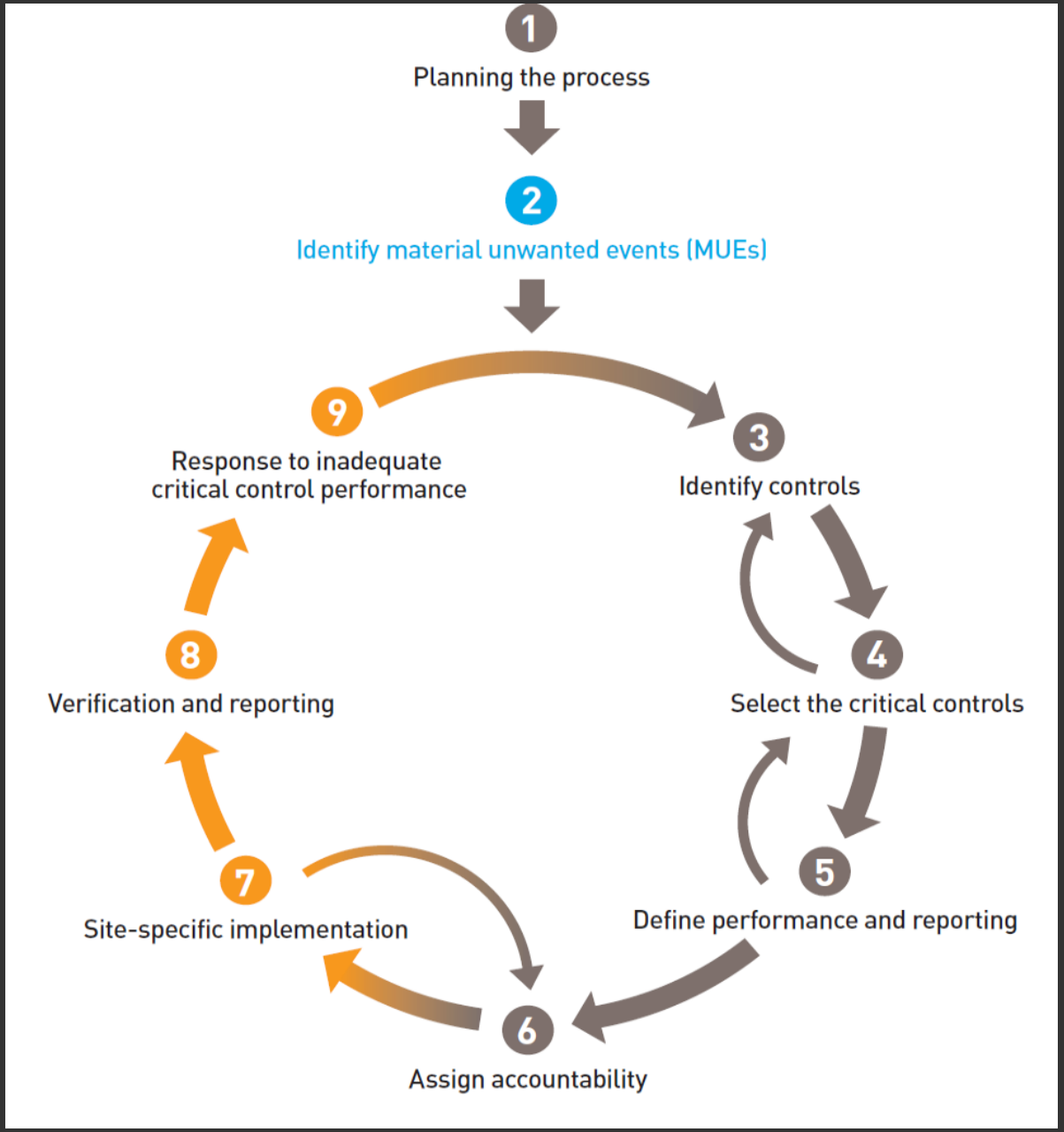
CRM Planning



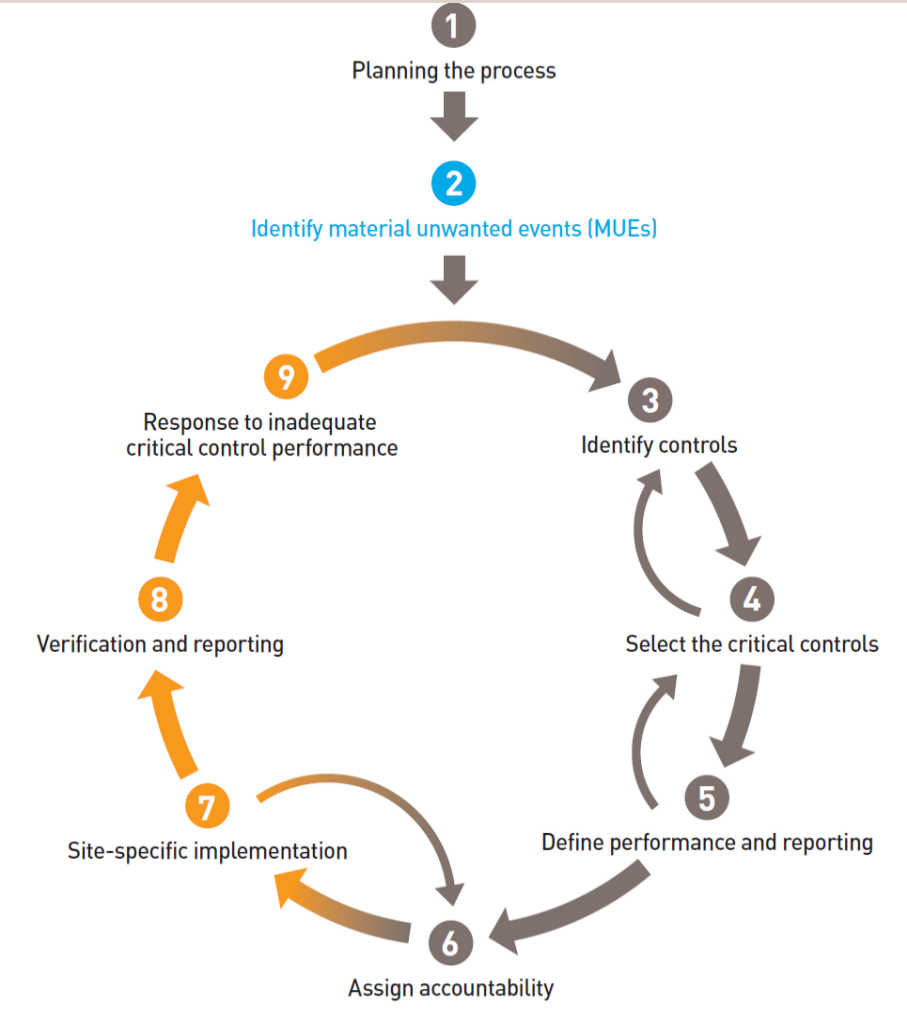
Desired outcome:

- Defined a plan for;
  - CRM Implementation
  - BAU CRM
- What good looks like?
  - A document (or section within a document) which defines the CRM process end to end.
  - Risk Owners, Control Owners, Critical Control Verifiers understand the CRM process.
  - Defined Materiality Criteria
- How does your business perform? (rating out of 10)

Identification of Material Unwanted Events



Identify Critical Risks



Desired outcome:

- Defined list of Critical Risks

Material Unwanted Events (MUEs)

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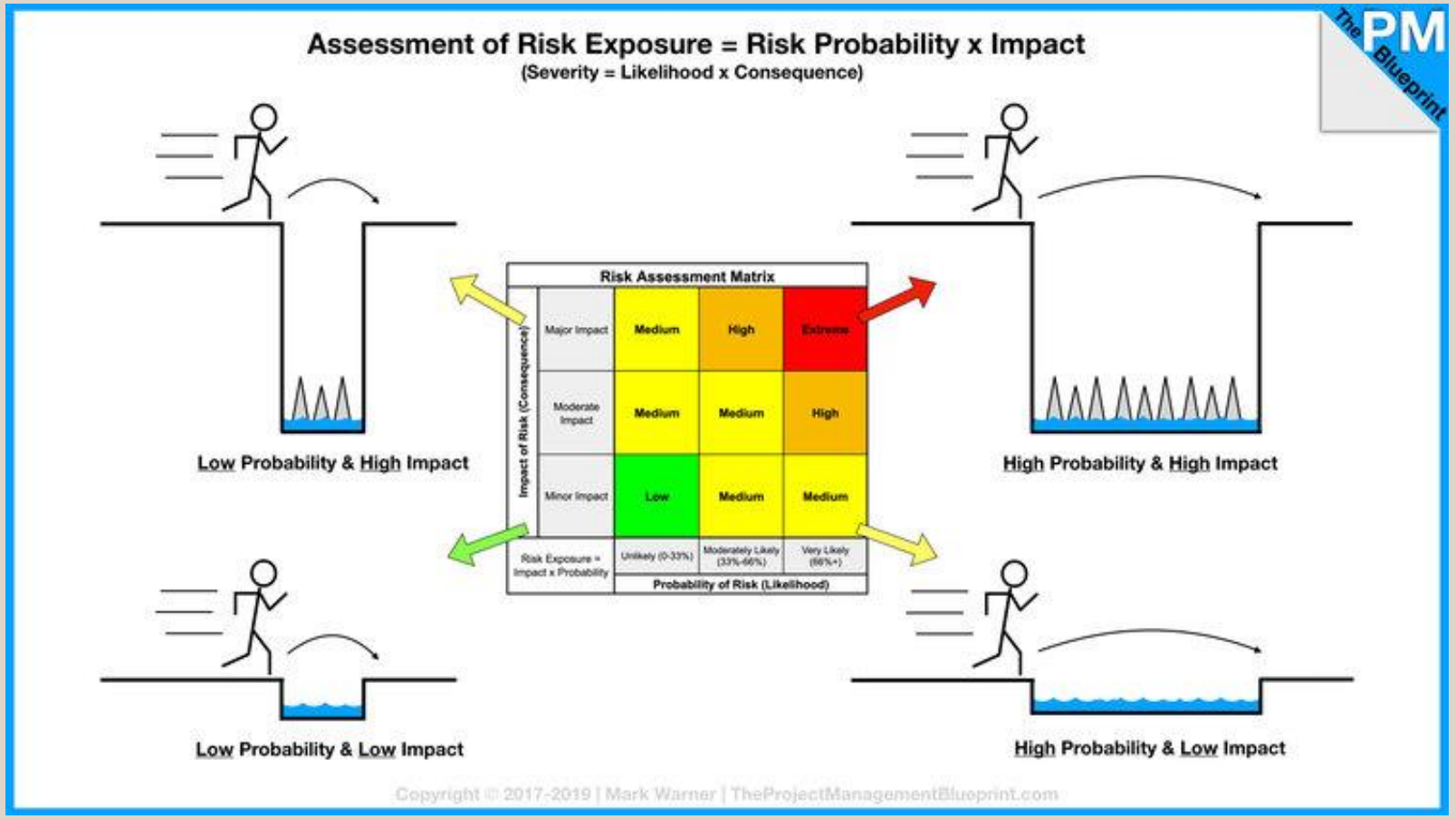
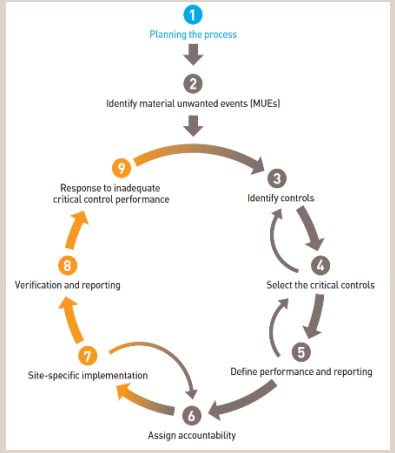


Material Unwanted Events (MUEs)

How do we go from here to here?



Materiality Criteria

- What is Materiality Criteria?

Materiality Criteria

- Materiality Criteria is the consequence criteria that meets the threshold for being classed as a Material Unwanted Event
- Each organisation must define their own materiality criteria
- In terms of “Safety” Consequence most organisations classify Single Fatality Consequence (or worse) as material
- Based on consequence type and consequence level

Materiality Criteria

Material Consequences will be included within the BBRA

Materiality Threshold

Immaterial Consequences will not be included within the BBRA Managed via other Risk Management (WRAC, JSA, SLAM)

	Health & Safety	Environment	Financial Impact	Image & Reputation / Community	Legal & Compliance
5 Catastrophic	• Multiple fatalities (2 or more fatalities in a single incident) • Multiple cases (5 or more) of Permanent Damage Injuries or Diseases that result in permanent disabilities in a single incident	• Unconfined and widespread • Environmental damage or effect (permanent; >10 years) • Requires major remediation	• >$600M investment return • >$100M operating profit • >$20M property damage	• Loss of multiple major customers or large proportion of sales contracts • Sustained campaign by one or more international NGOs resulting in physical impact on the assets or loss of ability to operate • Security incident resulting in multiple fatalities or major equipment damage • Formal expression of significant dissatisfaction by government • Grievance from internal or external stakeholder alleging human rights violation resulting in multiple fatalities	• Major litigation / prosecution at corporate level • Nationalisation / loss of licence to operate
4 Major	• Single incident resulting 1 Fatality Permanent Damage Injury or Disease that results in a permanent disability- less than 5 cases in a single incident	• Long-term (2 to 10 years) impact • Requires significant remediation	• $60-600M investment return • $20-100M operating profit • $2-20M property damage	• Security/ stakeholder incident resulting in single loss of life or equipment damage • Grievance from internal or external stakeholder alleging human rights violation resulting in single fatality or serious injuries • Topic of broad societal concern and criticism • Negative media coverage at international level resulting in a Corporate statement within 24 hours • Investigation from government and/ or international (or high-profile) NGOs • Complaints from multiple "final" customers • Loss of major customer • Negative impact on share price	• Major litigation / prosecution at Department level
3 Moderate	• Lost Time Injury (LTI) • Lost Time Disease (LTD) • Permanent Disabling Injury (PDI) • Permanent Disabling Disease (PDD) • Single incident that results in multiple medical treatments	• Medium-term (<2 years) impact (typically within a year) • Requires moderate remediation	• $6-60M investment return • $2-20M operating profit • $200K-2M property damage	• Negative media coverage at national level over more than one day • Complaint from a "final" customer • Off-spec product • Local Stakeholder action resulting in national societal scrutiny	• Major litigation / prosecution at Operation level
2 Minor	• Medical Treatment Injury (MTI) • Medical Treatment Disease (MTD) • Restricted Work Injury (RWI) • Restricted Work Disease (RWD)	• Near source • Short-term impact (typically <week) • Requires minor remediation	• $600K-6M investment return • $200K-2M operating profit • $10-200K property damage	• Negative local/ regional media coverage • Complaint received from an internal or external stakeholder	• Regulation breaches resulting in fine or litigation
1 Negligible	• First Aid Injury (FAI) or illness (not considered disease or disorder)	• Near source and confined • No lasting environmental damage or effect (typically <day) • Requires minor or no remediation	• <$600K investment return • <$200K operating profit • <$10K property damage	• Negligible media interest	• Regulation breaches without fine or litigation

Activity – Determine your materiality Criteria for MUEs

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4 Major	• Single incident resulting in: Less than 5 Fatalities Permanent Damage Injury or Disease that results in a permanent disability- less than 5 cases in a single incident	• Long-term (2 to 10 years) impact • Requires significant remediation	• $60-600M investment return • $20-100M operating profit • $2-20M property damage	• Security/ stakeholder incident resulting in single loss of life or equipment damage • Topic of broad societal concern and criticism • Negative media coverage at international level • Complaints from multiple "final" customers • Loss of major customer • Negative impact on share price	• Major litigation / prosecution at Department level
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Materiality Criteria

- Can Materiality Criteria Change?

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Do you have a risk-based process to identify your Critical Risks?

Broad Brush Risk Assessment

Broad Brush Risk Assessment (BBRA)

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- Sometimes called Base Line Risk Assessment (BLRA).
- The objective of the BBRA is to look across an entire organisation or site, identify the hazards, find potential MUEs and prioritise them.
- Often completed in the WRAC template

Geographic Area	Hazard / Risk Source Classification	Hazard / Risk Source Description	Release Mechanism *Example of how this energy can be released (unwanted events)*	Description of Unwanted Event	Maximum consequence *(with no controls)*	Material Unwanted Event *(Yes, No)*	Functional Ownership	Current Controls	Likelihood of the Event *(given current controls)*	Consequence Types *(given current controls)*						Max Risk Rank
										(H&S	(E)	(F)	(R)	(L&R)	(S&C)	
Underground	Mechanical (Mobile)	Underground Mobile Equipment	Single Vehicle Incident (Rollover, runaway, uncontrolled movement, break through windrow, runaway vehicle) Multiple Vehicle Incident (Vehicle Collision), Pedestrian Strike	Loss of control of mobile equipment (underground)	C6: Ext	Yes	Open Pit Manager Mining	Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard TM & SD - Areas where mobile equipment operates PHMP TM & SD - Traffic Management Plans TM & SD - Underground Traffic Management Plan	L4: Likely	C6: Ext						34 (E)
Surface	Mechanical (Mobile)	Surface Mobile Equipment	Single Vehicle Incident (Rollover, runaway, uncontrolled movement, contact with infrastructure, contact with Pit wall) Multiple Vehicle Incident (Vehicle Collision), Pedestrian Strike, bussing of personnel SD - Haulage vehicles crossing public access road Autonomous drill interaction or uncontrolled movement	Loss of control of mobile equipment (surface)	C6: Ext	Yes	Open Pit Manager Mining	Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard TM & SD - Areas where mobile equipment operates PHMP TM & SD - Traffic Management Plans SD - Autonomous Equipment Management Plan	L4: Likely	C6: Ext						34 (E)
Offlease	Mechanical (Mobile)	Offsite vehicle incident	Journey incident, Single Vehicle Incident, vehicle Collision,	Loss of control of vehicle offsite	C6: Ext	Yes	Open Pit Manager Mining	Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard SD - Offsite Journey Management and Remote Area Access Procedure TM - Drive in and Drive Out Procedure	L4: Likely	C6: Ext						34 (E)
Whole of Site	Mechanical (Fixed)	Collapse of Structure	Processing plant structural failure, Tank Failure, Conveyor structure failure, Bin Structural Failure, Failure of concrete foundations	Collapse of Structure	C6: Ext	Yes	Chief Engineer	TM - TGM Scaffolding Management Plan SD - Classified Plant Procedure Third Party Annual Structural Integrity Audit	L3: Unlikely	C6: Ext						32 (E)
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Whole of Site	Confined Spaces	Confined Spaces	Toxic Atmosphere, Engulfment, Irrespirable atmosphere flammable atmosphere Tanks, chutes, pits, mobile plant spaces,	Exposure to toxic or irrespirable atmosphere in confined space	C6: Ext	Yes	Processing Manager	TM - Confined Spaces Procedure TM - Permit to Work and Isolations Procedure SD - PTW - Confined Entry Procedure SD - PTW Permit to Work	L2: Very Unlikely	C6: Ext						30 (M)
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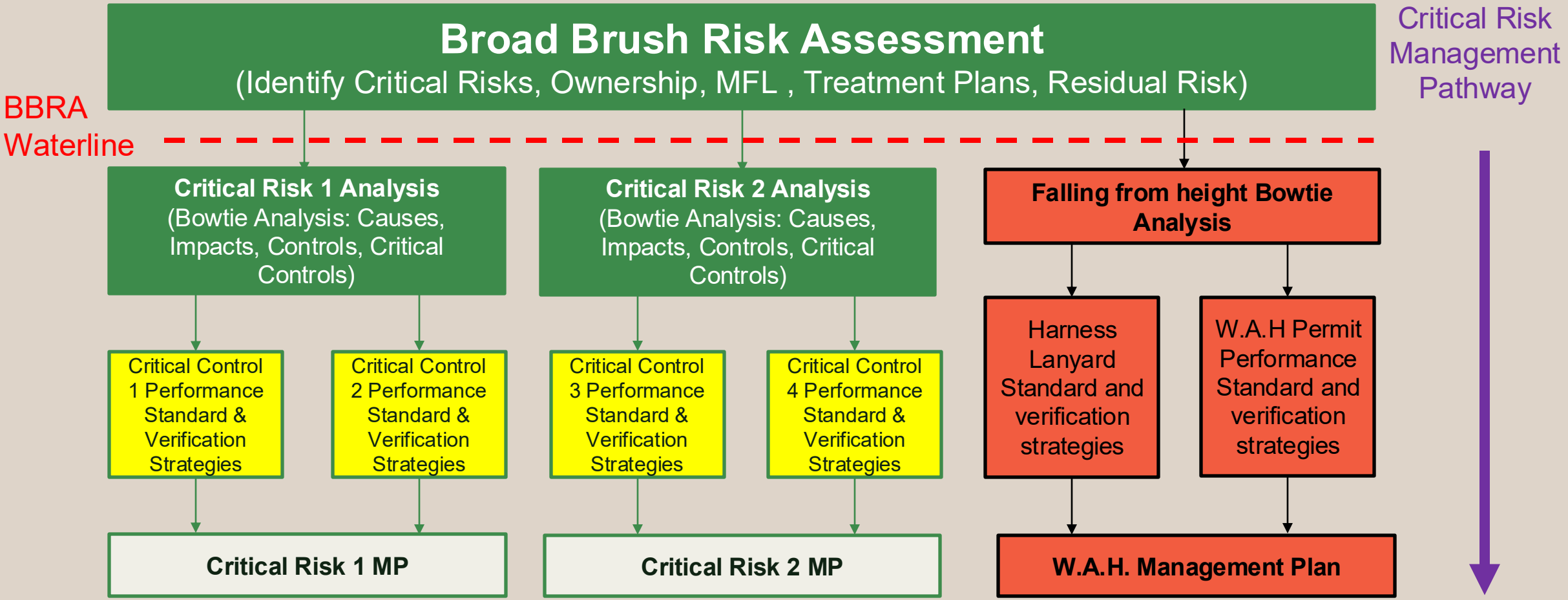
Surface	Fire	Surface Fire	Building fire, conveyor fire, tyre fire, bush fire, warehouse, hazardous substance, Mobile Equipment Fire, Mill Fire, Lithium batteries in battery propelled transport (e.g. buggy's).	Surface fire	C5: Maj	Yes		Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard SD - Fire Explosions PHMP TM - Fire Explosions PHMP SD - Fire Protection Equipment Procedure SD - Fire Protection Systems Impairment Procedure	L2: Very Unlikely	C5: Maj						27 (M)

CRM Framework



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Is it Risks or Activities?

Which one?

Working at Height

- Work from; EWP, Scaffold,

Fall from Height

- Fall to same level
- Fall to level below
- Fall from height
- Scenarios; Fall into body of water / liquid, Fall onto other person, fall from mobile equipment, fall into open hole, fall over open edge,

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Controls or no Controls?

Risk Identification

- Risks are identified based on Consequence without controls - Maximum Foreseeable Loss.
- Residual risk ratings are used to drive prioritisation

Geographic Area	Hazard / Risk Source Classification	Hazard / Risk Source Description	Release Mechanism *Example of how this energy can be released (unwanted events)*	Description of Unwanted Event	Maximum consequence *(with no controls)*	Material Unwanted Event *(Yes, No)*	Functional Ownership	Current Controls	Likelihood of the Event *(given current controls)*	Consequence Types *(given current controls)*							Max Risk Rank
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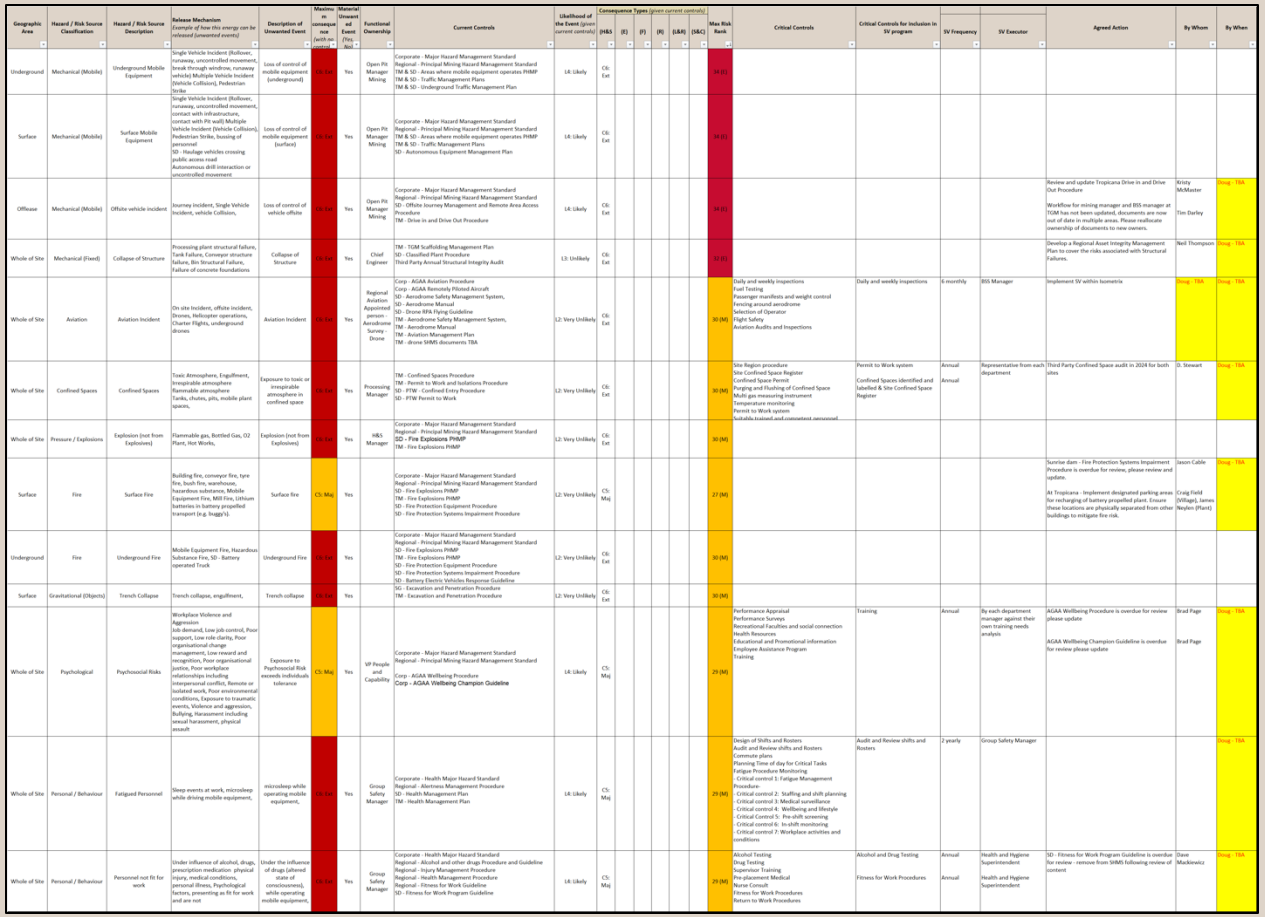
Identify Critical Risks



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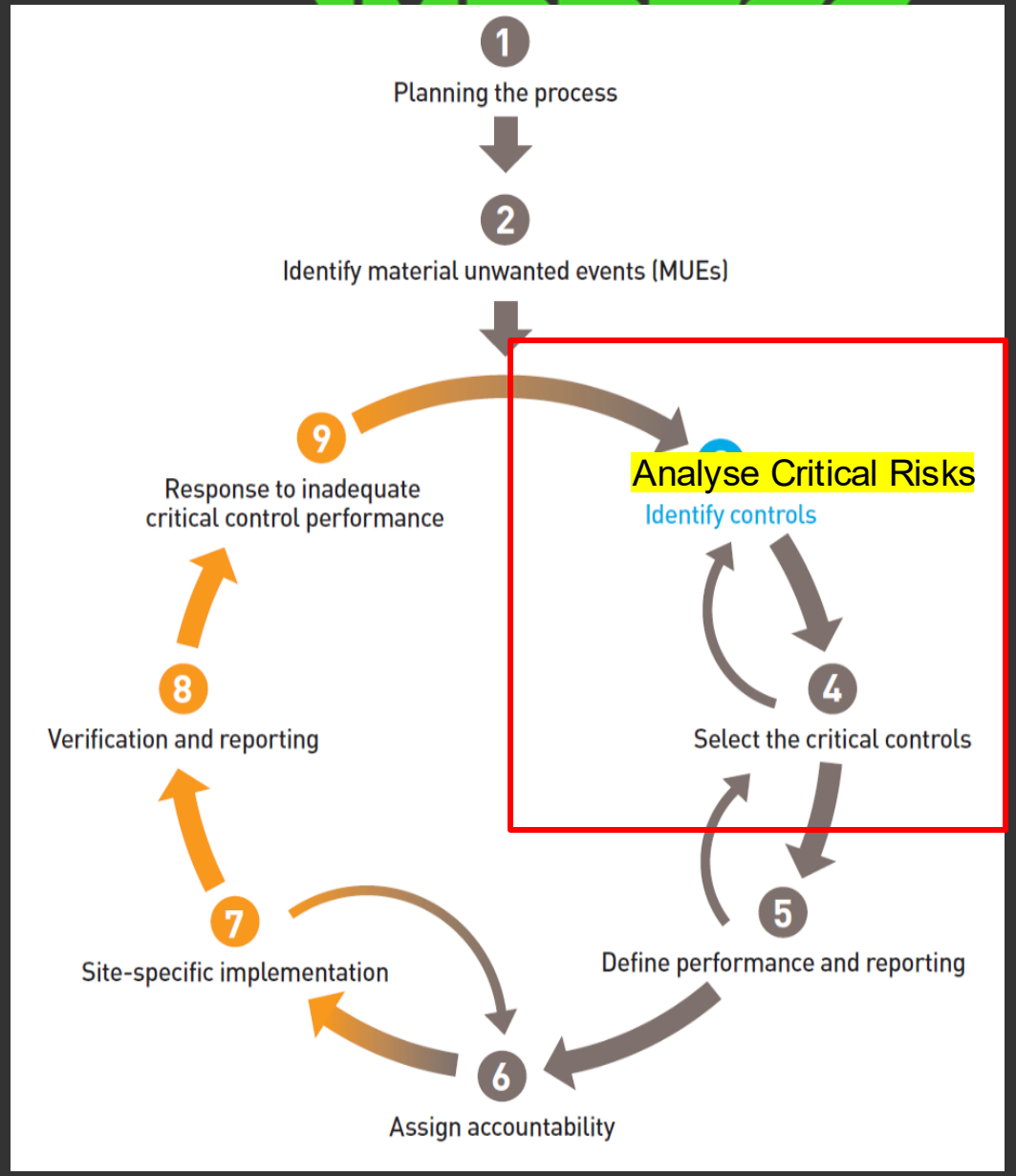
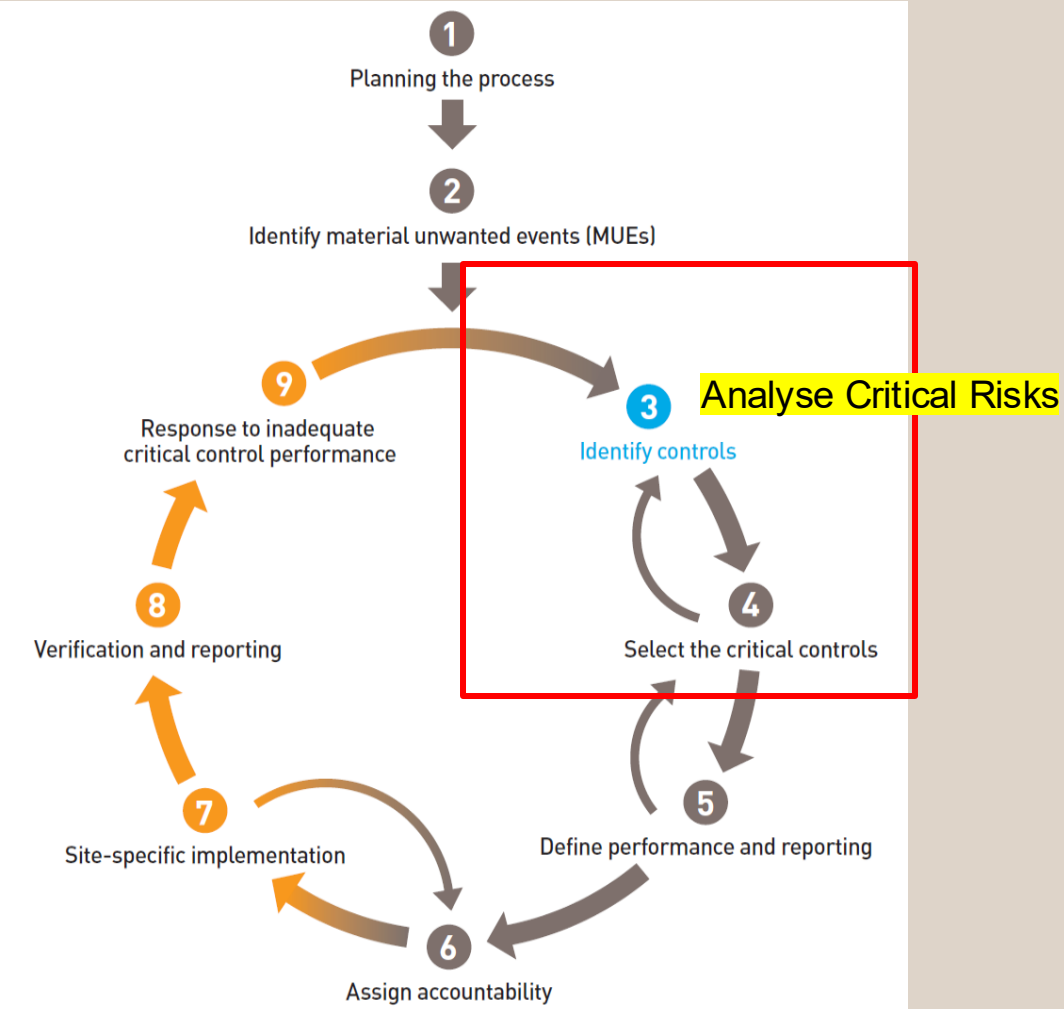
Whole of Site	Mechanical (Fixed)	Collapse of Structure	Processing plant structural failure, Tank Failure, Conveyor structure failure, Bin Structural Failure, Failure of concrete foundations	Collapse of Structure	C6: Ext	Yes	Chief Engineer	TM - TGM Scaffolding Management Plan SD - Classified Plant Procedure Third Party Annual Structural Integrity Audit	L3: Unlikely	C6: Ext						32 (E)					Develop a Regional Asset Integrity Management Plan to cover the risks associated with Structural Failures.	Neil Thompson	Doug - TBA
Whole of Site	Aviation	Aviation Incident	On site Incident, offsite incident, Drones, Helicopter operations, Charter Flights, underground drones	Aviation Incident	C6: Ext	Yes	Regional Aviation Appointed person - Aerodrome Survey - Drone	Corp - AGAA Aviation Procedure Corp - AGAA Remotely Piloted Aircraft SD - Aerodrome Safety Management System, SD - Aerodrome Manual SD - Drone RPA Flying Guideline TM - Aerodrome Safety Management System, TM - Aerodrome Manual TM - Aviation Management Plan TM - drone SHMS documents TBA	L2: Very Unlikely	C6: Ext						30 (M)	Daily and weekly inspections Fuel Testing Passenger manifests and weight control Fencing around aerodrome Selection of Operator Flight Safety Aviation Audits and Inspections	Daily and weekly inspections	6 monthly	BSS Manager	Implement SV within Isometrix	Doug - TBA	Doug - TBA
Whole of Site	Confined Spaces	Confined Spaces	Toxic Atmosphere, Engulfment, Irrespirable atmosphere flammable atmosphere Tanks, chutes, pits, mobile plant spaces,	Exposure to toxic or irrespirable atmosphere in confined space	C6: Ext	Yes	Processing Manager	TM - Confined Spaces Procedure TM - Permit to Work and Isolations Procedure SD - PTW - Confined Entry Procedure SD - PTW Permit to Work	L2: Very Unlikely	C6: Ext						30 (M)	Site Region procedure Site Confined Space Register Confined Space Permit Purging and Flushing of Confined Space Multi gas measuring instrument Temperature monitoring Permit to Work system Suitably trained and competent personnel	Permit to Work system Confined Spaces identified and labelled & Site Confined Space Register	Annual Annual	Representative from each department	Third Party Confined Space audit in 2024 for both sites	D. Stewart	Doug - TBA
Whole of Site	Pressure / Explosions	Explosion (not from Explosives)	Flammable gas, Bottled Gas, O2 Plant, Hot Works,	Explosion (not from Explosives)	C6: Ext	Yes	H&S Manager	Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard SD - Fire Explosions PHMP TM - Fire Explosions PHMP	L2: Very Unlikely	C6: Ext						30 (M)							
Surface	Fire	Surface Fire	Building fire, conveyor fire, tyre fire, bush fire, warehouse, hazardous substance, Mobile Equipment Fire, Mill Fire, Lithium batteries in battery propelled transport (e.g. buggy's).	Surface fire	C5: Maj	Yes		Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard SD - Fire Explosions PHMP TM - Fire Explosions PHMP SD - Fire Protection Equipment Procedure SD - Fire Protection Systems Inquairment Procedure	L2: Very Unlikely	C5: Maj						27 (M)					Sunrise dam - Fire Protection Systems Inquairment Procedure is overdue for review, please review and update. At Tropicana - Implement designated parking areas for recharging of battery propelled plant. Ensure these locations are physically separated from other buildings to mitigate fire risk.	Jason Cable Craig Field (Village), James Neylen (Plant)	Doug - TBA
Underground	Fire	Underground Fire	Mobile Equipment Fire, Hazardous Substance Fire, SD - Battery operated Truck	Underground Fire	C6: Ext	Yes		Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard SD - Fire Explosions PHMP TM - Fire Explosions PHMP SD - Fire Protection Equipment Procedure SD - Fire Protection Systems Inquairment Procedure SD - Battery Electric Vehicles Response Guideline	L2: Very Unlikely	C6: Ext						30 (M)							
Surface	Gravitational (Objects)	Trench Collapse	Trench collapse, engulfment,	Trench collapse	C6: Ext	Yes		SG - Excavation and Penetration Procedure TM - Excavation and Penetration Procedure	L2: Very Unlikely	C6: Ext						30 (M)							
Whole of Site	Psychological	Psychosocial Risks	Workplace Violence and Aggression Job demand, Low job control, Poor support, Low role clarity, Poor organisational change management, Low reward and recognition, Poor organisational justice, Poor workplace relationships including interpersonal conflict, Remote or isolated work, Poor environmental conditions, Exposure to traumatic events, Violence and aggression, Bullying, Harassment including sexual harassment, physical assault	Exposure to Psychosocial Risk exceeds individuals tolerance	C5: Maj	Yes	VP People and Capability	Corporate - Major Hazard Management Standard Regional - Principal Mining Hazard Management Standard Corp - AGAA Wellbeing Procedure **Corp - AGAA Wellbeing Champion Guideline**	L4: Likely	C5: Maj						29 (M)	Performance Appraisal Performance Surveys Recreational Faculties and social connection Health Resources Educational and Promotional information Employee Assistance Program Training	Training	Annual	By each department manager against their own training needs analysis	AGAA Wellbeing Procedure is overdue for review please update AGAA Wellbeing Champion Guideline is overdue for review please update	Brad Page Brad Page	Doug - TBA
Whole of Site	Personal / Behaviour	Fatigued Personnel	Sleep events at work, microsleep while driving mobile equipment,	microsleep while operating mobile equipment,	C6: Ext	Yes	Group Safety Manager	Corporate - Health Major Hazard Standard Regional - Alertness Management Procedure SD - Health Management Plan TM - Health Management Plan	L4: Likely	C5: Maj						29 (M)	Design of Shifts and Rosters Audit and Review shifts and Rosters Commute plans Planning Time of day for Critical Tasks Fatigue Procedure Monitoring - Critical control 1: Fatigue Management Procedure- - Critical control 2: Staffing and shift planning - Critical control 3: Medical surveillance - Critical control 4: Wellbeing and lifestyle - Critical Control 5: Pre-shift screening - Critical control 6: In-shift monitoring - Critical control 7: Workplace activities and conditions	Audit and Review shifts and Rosters	2 yearly	Group Safety Manager			Doug - TBA
Whole of Site	Personal / Behaviour	Personnel not fit for work	Under influence of alcohol, drugs, prescription medication physical injury, medical conditions, personal illness, Psychological factors, presenting as fit for work and are not	Under the influence of drugs (altered state of consciousness), while operating mobile equipment,	C6: Ext	Yes	Group Safety Manager	Corporate - Health Major Hazard Standard Regional - Alcohol and other drugs Procedure and Guideline Regional - Injury Management Procedure Regional - Health Management Procedure Regional - Fitness for Work Guideline SD - Fitness for Work Program Guideline	L4: Likely	C5: Maj						29 (M)	Alcohol Testing Drug Testing Supervisor Training Pre-placement Medical Nurse Consult Fitness for Work Procedures Return to Work Procedures	Alcohol and Drug Testing Fitness for Work Procedures	Annual Annual	Health and Hygiene Superintendent Health and Hygiene Superintendent	SD - Fitness for Work Program Guideline is overdue for review - remove from SHMS following review of content	Dave Markiewicz	Doug - TBA

- Desired outcome:
  - Defined list of Critical Risks
- What good looks like?
  - Broad Brush Risk Assessment (BBRA) reviewed annually
  - Risk Owners identified
  - SHMS Gap Analysis
    - (i.e. is there an in date, SHMS document for each Critical Risk)
- How does your business perform?

Analyse MUEs



Analyse Critical Risks



Desired outcome:

- A Risk Analysis is performed of each Critical Risk to identify;
  - Causes
  - Consequences
  - SMART Preventative and Mitigating Controls
  - Control Effectiveness Score
  - Critical Controls
  - Critical Control failure modes and Prevention Strategies.

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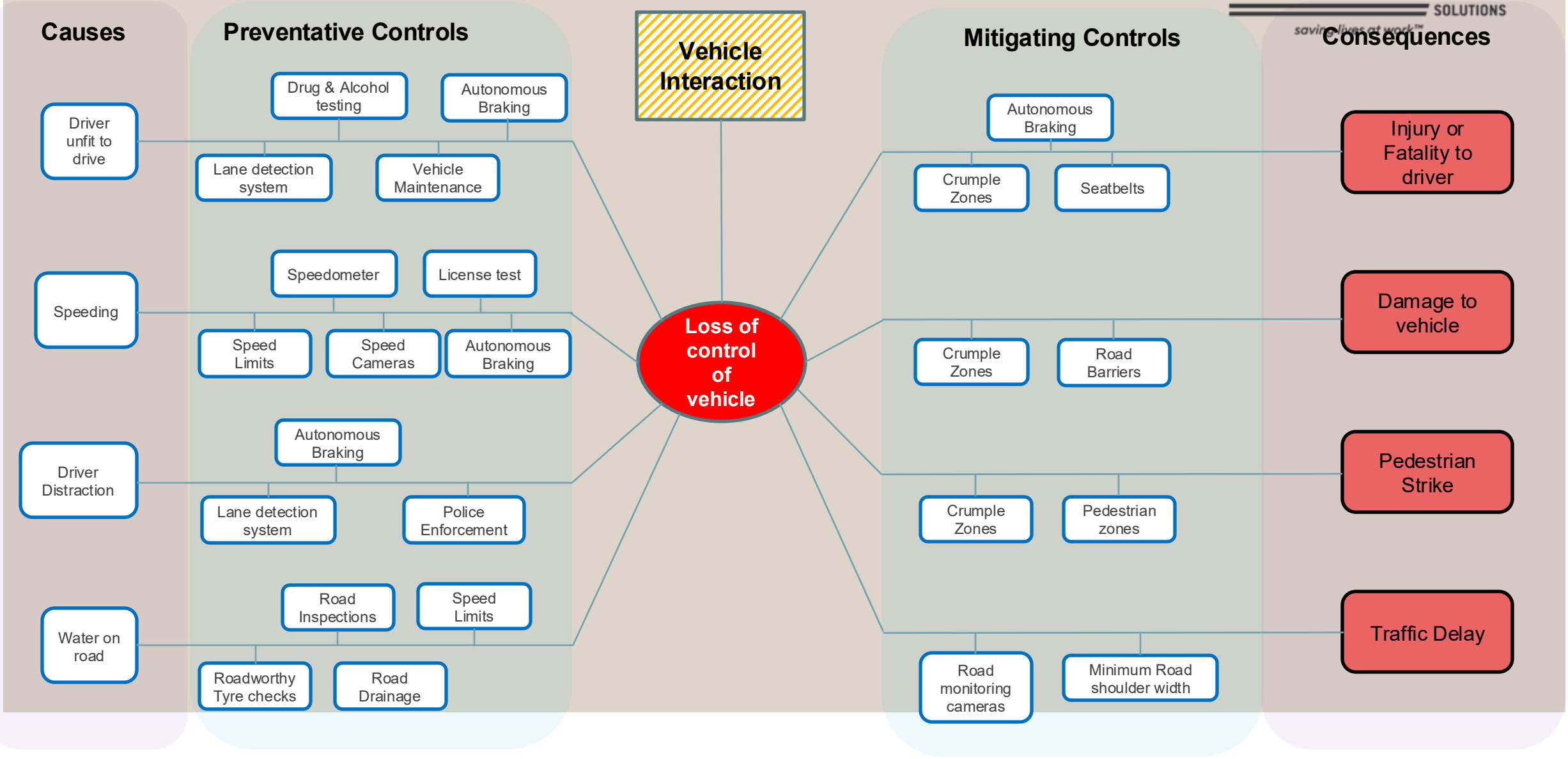
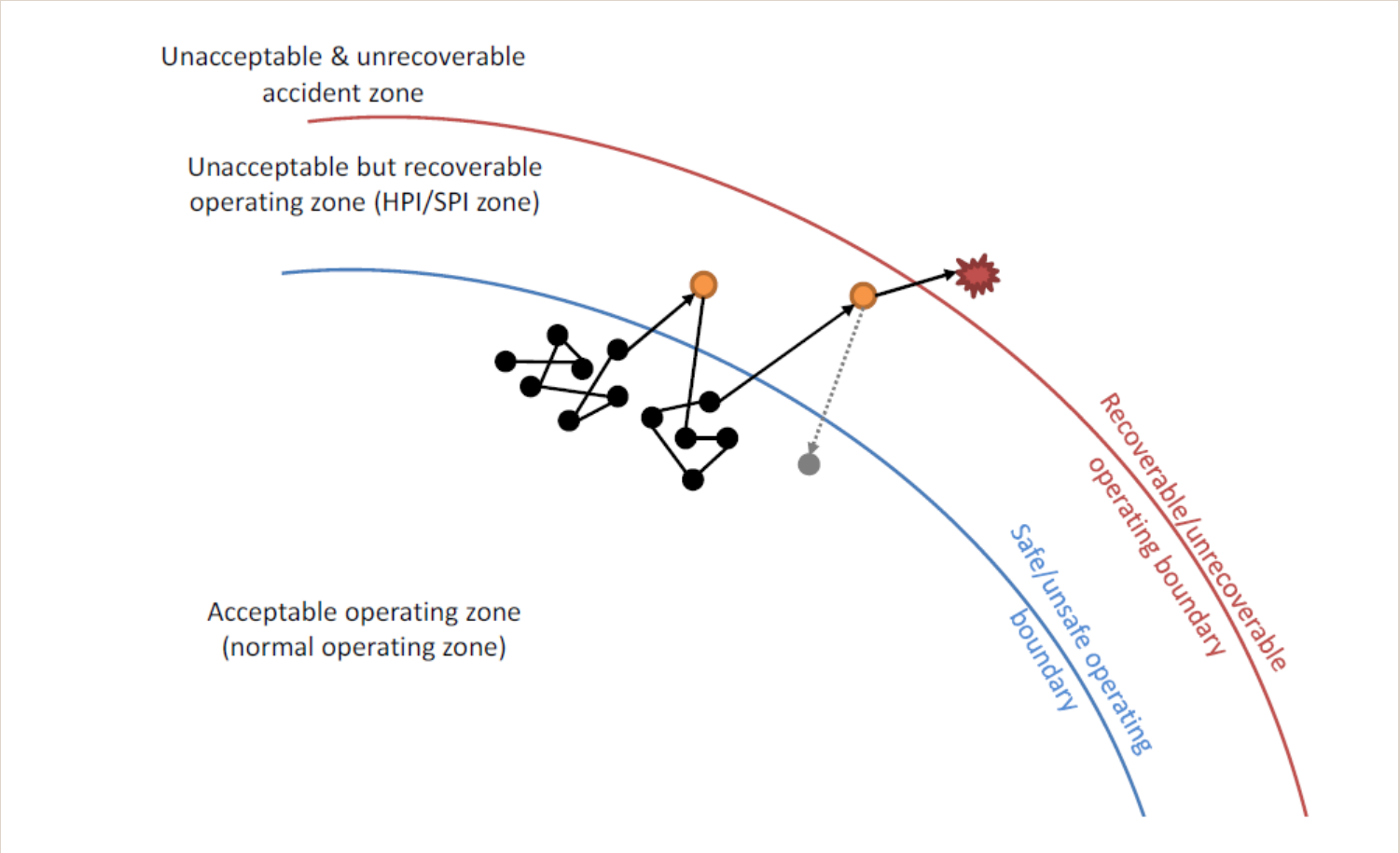
What method do we use to analyse Critical Risks?

Example Bowtie



Define the Unwanted Event



- Bowtie Activity

Identify Controls

A Control

- Is;
  - An act, or,
  - An object (engineered), or,
  - A technological system (combination of act and object),

- Must be;
  - Intended to arrest or mitigate an unwanted event.
  - Specifiable, measurable and auditable
  - Linked to a management system [impress]

Adapted from: Rasmussen & Svedung, 2000; Leveson, 2004.

Act

- A human ‘act’, which of itself, arrests or mitigates an unwanted event.

- The defined human act may be derived from;
  - A procedure (e.g.. Road rules manual)
  - Training content (e.g.. Driver training prior to getting license) or
  - Experience in applying specific practices in the given situation (e.g.. slowing down when driving in wet weather).

Question?

- Is “Isolation Procedure” an ‘act’ type control for the hazard of “Incorrect isolation” ?

- No
  - The “Isolation Procedure” does not define the ‘act’

- More appropriate Control Description
  - Look inside the procedure for the specific ‘act’ which controls this hazard
    - e.g.. “Test the system is de-energised prior to commencing work”
  - List this as the control

Object

- A physical, ‘engineered’ or designed ‘object’, which of itself, would arrest or mitigate an unwanted event.

- It can be described as follows;
  - Automatically actuated or operated, not relying upon a human act to actuate or operate,
  - Passive (e.g.. road side barriers)
  - Active (e.g.. airbags, crumple zones),
  - Operated based on software (e.g.. Traction control will operate if the car senses a loss of traction)

Question?

- Which of the following are object type controls?
  - Seatbelts
  - Boom gates at rail crossings
  - Fire sensors and alarm

- Answer
  - Fire sensors and alarm
  - The other two require ‘acts’ to enable their success

System

- A combination of a act and an object.
- An object control that requires human acts to actuate, operate or respond.
  - Also called a ‘technological system’ control.

- It can be described as follows;
  - Technology reliant upon a human act to actuate or operate when required such as a response to an alarm, and
  - Passive (e.g.. seatbelts need to be worn) or
  - Active (e.g.. reversing sensors prompt driver action).

Question?

- Which of the following are system controls?
  - Traffic Lights
  - Fire Extinguishers
  - Vehicle air bags

- Answer
  - Traffic Lights
  - Fire Extinguishers

Specific, Measurable, Auditable

- Specificity:
  - How would you describe the control to someone else such that they would know what to look for
  - E.g.. all drivers must drive a maximum 40km/hr through a school zone
- Measurability:
  - How can you measure if it's working or not
  - E.g.. GPS tracking,
- Auditability:
  - How could you audit its effectiveness
  - E.g.. Review GPS logs, in field observations with radar gun

Question?

- Which of the following are specific, measurable and auditable?
  - Everyone must be inducted
  - Induction Training Package
  - All employees must receive defensive driver training prior to driving a company vehicle.

- Answer – pretty clear
  - How would you describe the control to someone else such that they would know what to look for
  - How can you measure if it's working or not
  - How could you audit its effectiveness

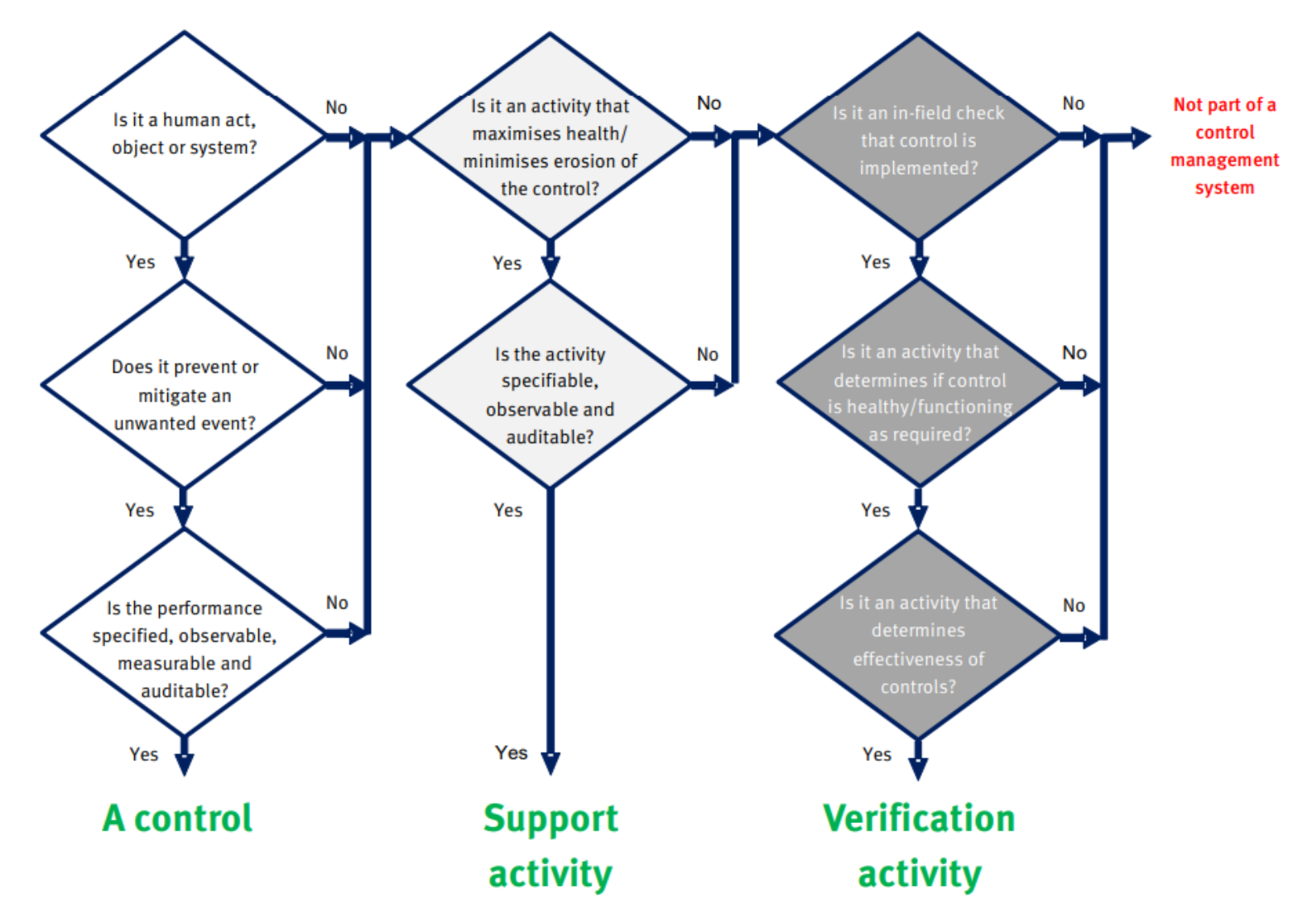
Preventative & Mitigating Controls

- Preventative Control:
  - Prevents the hazard from being realized
    - E.g.. Speed limit signage, road markings
  - Two objectives;
    1. Prevent the cause from occurring, and,
    2. If the cause occurs, prevent it from leading to the unwanted event
  - Prompt Question to identify preventative controls “How do we prevent the hazard from being released?”, How do we keep control?”

- Mitigating Control:
  - Mitigates the consequence of the hazard should it be realized
    - E.g.. Guard rails, vehicle crumple zones
  - Prompt questions to identified mitigating controls “How do we limit the severity of the unwanted event?”, “How do we minimise the effects?”

Control Decision Tree

- The decision tree has been constructed to assist with the determination of a control.
- This definition of control means that elements like policies, procedures, “common sense” are NOT controls.



Source: The State of Queensland (Mining Safety and Health Advisory Committee) Risk assessment education resource.

Which of these are Controls, Support Activities, Monitoring Activities, or None

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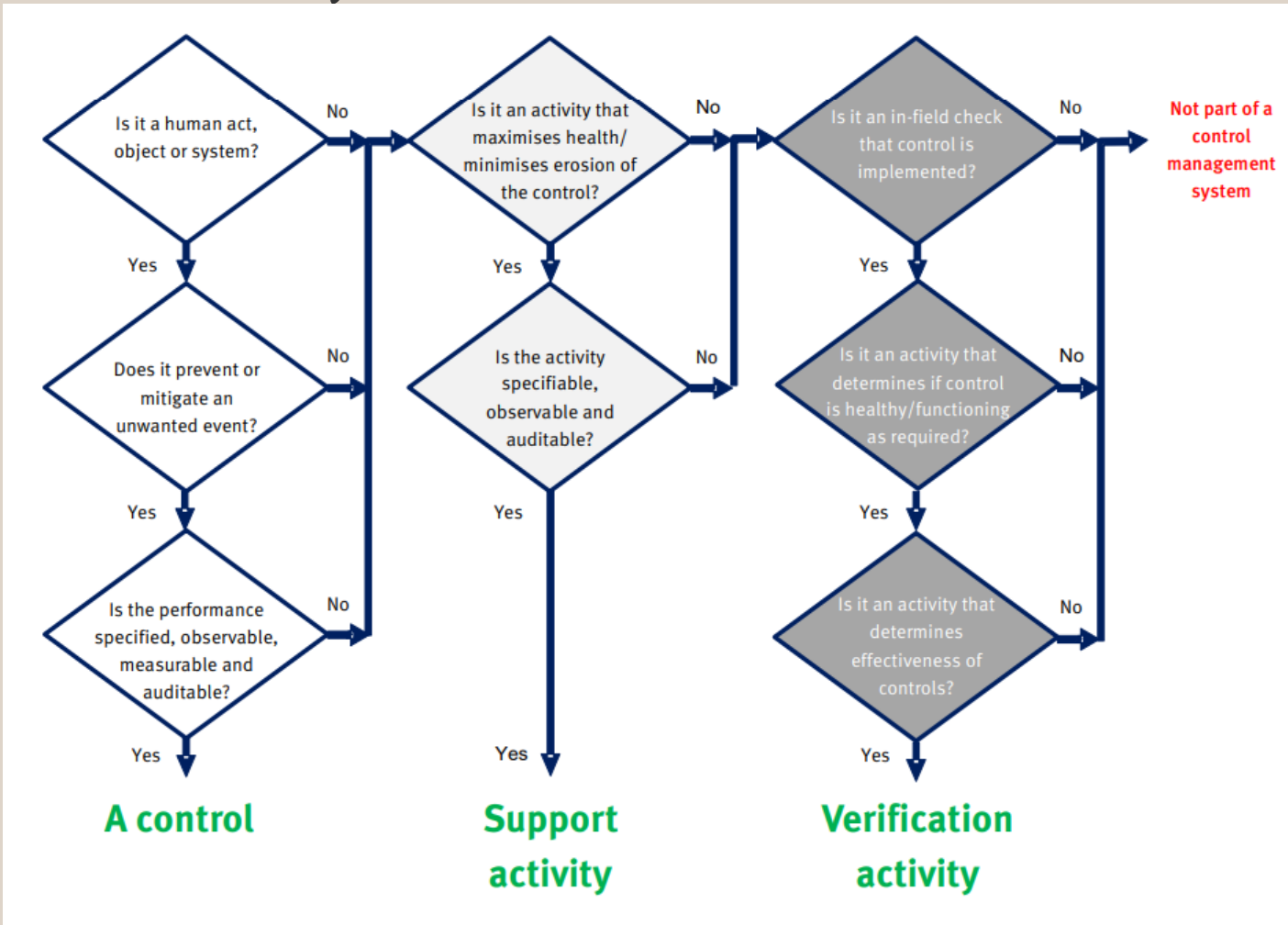
- Induction
- Supervisor Inspections
- Barricading of drop zones
- Hot Work Permit
- Alcohol and Drug Testing
- Emergency Response Plan
- Preventative Maintenance



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Are all these controls as strong or as effective as each other?

Adequacy of individual controls

- This is an assessment of whether the selected control is designed to robustly and reliably deliver the desired control action as required when required.
- If an individual control is assessed as not being sufficiently robust and reliable (and that cannot be improved to a satisfactory level?), it is recommended that the control be replaced by a better control or the control be supplemented with additional controls.

Control Effectiveness Assessments

- Combination of Control Quality and Control Impact
- Template uses a 3 point scale

CONTROL QUALITY		No object/ technology component to control	Coverage, availability and reliability of OBJECT/TECHNOLOGY component of control				
			Works in >95% of scenarios/areas	Works in 90%-95% of scenarios/areas	Works in 75%-90% of scenarios/areas	Works in 50%-75% of scenarios/areas	Works in <50% of scenarios/areas
No human action component to control			Excellent	Very Good	Good	Poor	Very poor
Coverage, availability and reliability of HUMAN ACTION component of control	Works in >95% of scenarios/areas	Excellent	Excellent	Very Good	Good	Poor	Very poor
	Works in 90%-95% of scenarios/areas	Very Good	Very Good	Good	Good	Poor	Very poor
	Works in 75%-90% of scenarios/areas	Good	Good	Good	Poor	Poor	Very poor
	Works in 50%-75% of scenarios/areas	Poor	Poor	Poor	Poor	Very poor	Very poor
	Works in <50% of scenarios/areas	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor

CONTROL EFFECTIVENESS		CONTROL IMPACT - Degree to which the control impacts residual risks				
		Significant impact	Impact	Slight impact	No impact	Adverse impact
		Presence/action of control significantly reduces residual risk. Absence/failure of control significantly increases the residual risk	Presence/action of control reduces residual risk. Absence/failure of control increases the residual risk	Presence/action of control slightly decreases the residual risk. Absence/failure of control slightly increases the residual risk	Presence/action or absence/ failure of the control does not change the residual risk	Presence/action of control has potential to increase residual risk
CONTROL QUALITY from matrix one	Excellent	Highly adequate	Very good adequacy	Marginally adequate	Poor adequacy	Inadequate
	Very Good	Very good adequacy	Very good adequacy	Marginally adequate	Poor adequacy	Inadequate
	Good	Very good adequacy	Very good adequacy	Marginally adequate	Poor adequacy	Inadequate
	Poor	Marginally adequate	Marginally adequate	Poor adequacy	Inadequate	Inadequate
	Very poor	Poor adequacy	Poor adequacy	Inadequate	Inadequate	Inadequate

Source: M. Hassall, J. Joy, C. Doran and M. Punch, Selection and Optimisation of Risk Controls. ACARP report no C23007, 2015.

CONTROL QUALITY		No object/ technology component to control	Coverage, availability and reliability of OBJECT/TECHNOLOGY component of control				
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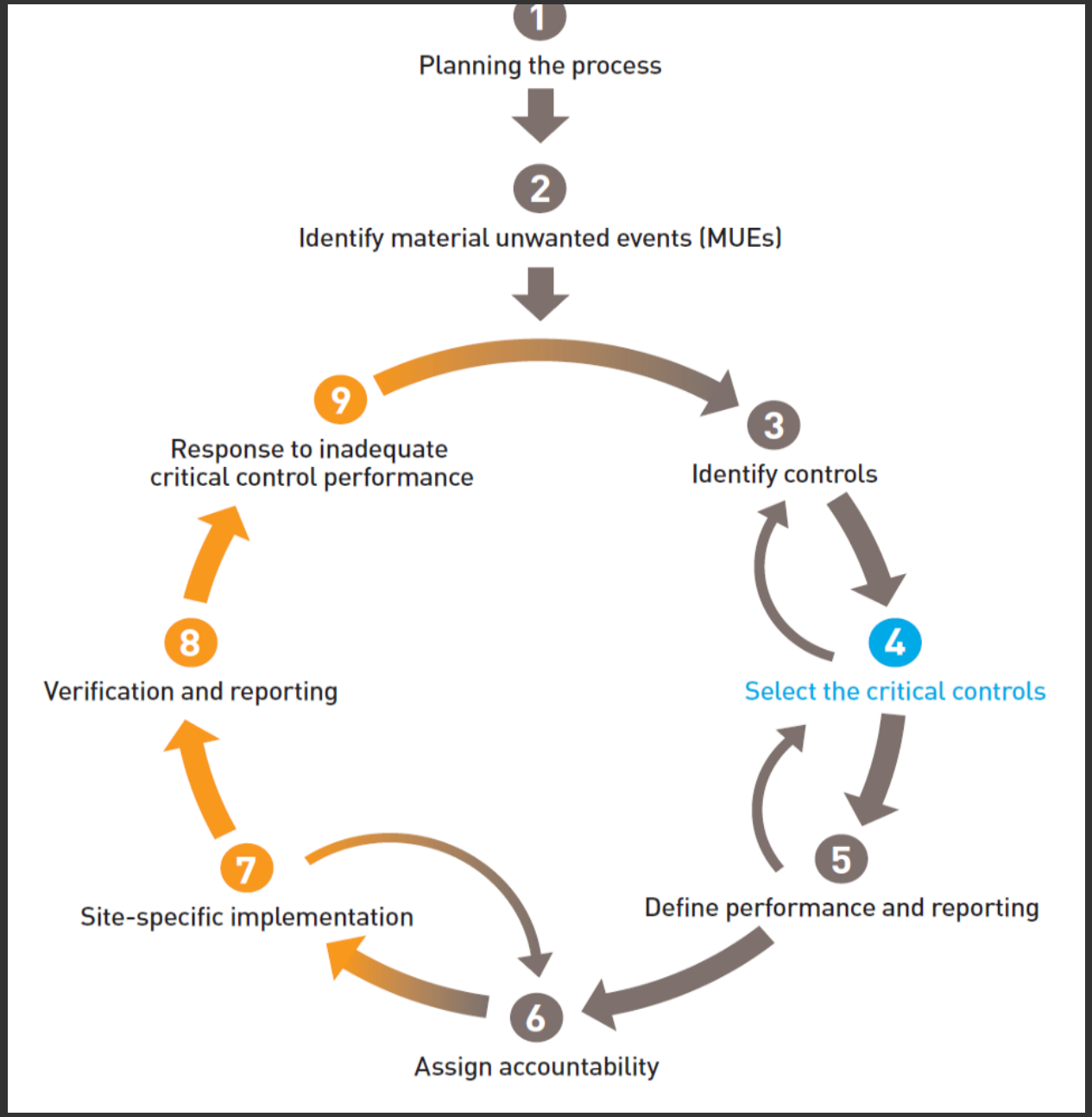
CONTROL QUALITY from matrix one	Excellent	Highly adequate	Very good adequacy	Marginally adequate	Poor adequacy	Inadequate
	Very Good	Very good adequacy	Very good adequacy	Marginally adequate	Poor adequacy	Inadequate
	Good	Very good adequacy	Very good adequacy	Marginally adequate	Poor adequacy	Inadequate
	Poor	Marginally adequate	Marginally adequate	Poor adequacy	Inadequate	Inadequate
	Very poor	Poor adequacy	Poor adequacy	Inadequate	Inadequate	Inadequate

Source: M. Hassall, J. Joy, C. Doran and M. Punch, Selection and Optimisation of Risk Controls. ACARP report no C23007, 2015.

Select Critical Controls



Critical Control

- What is a Critical Control?
- How is it different from a ‘control’?

To be considered as a Critical Control it

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1. Must be a Control

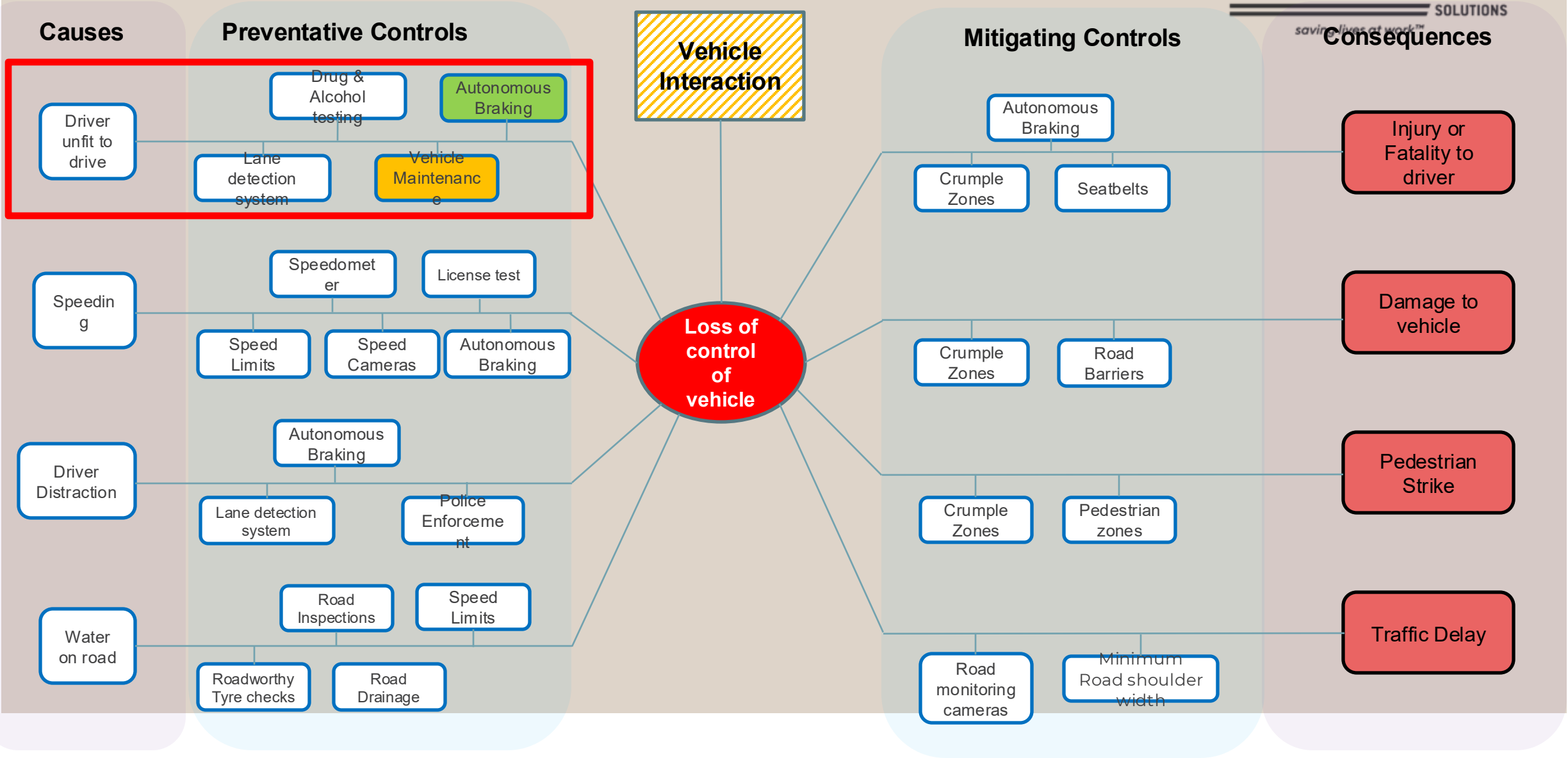
- An act, object (engineered), or technological system (combination of act and object), intended to arrest or mitigate an unwanted event.
- Specific, Measurable and Auditable
- Described within a Management System
- Must not be a Support Activity or Verification Activity

2. Must be Critical

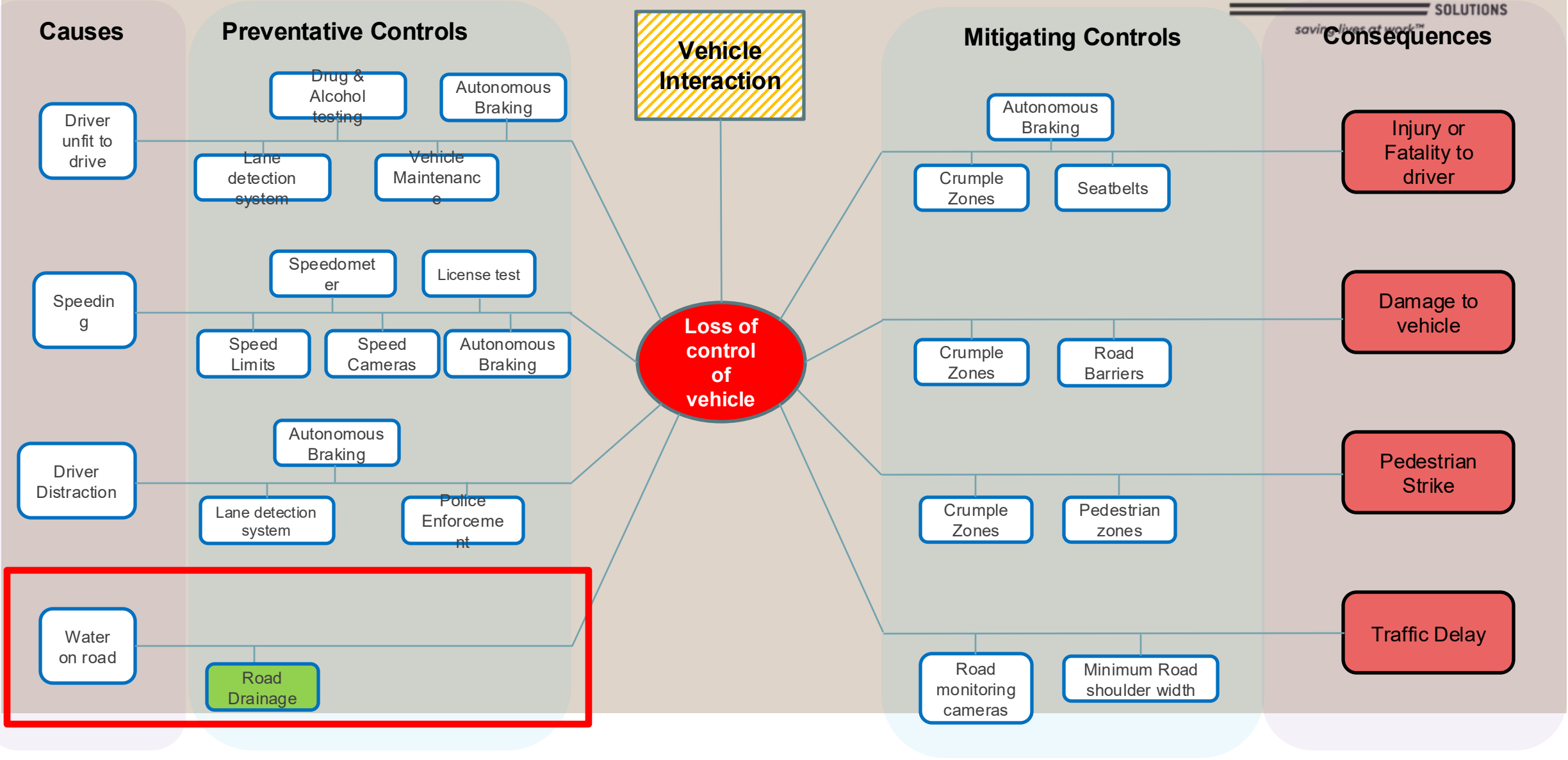
- **Critical** to preventing a Major Unwanted Event (MUE) or minimising its consequences.
- It's **the only control** to prevent or mitigate the unwanted event.
- It's **absence or failure** would significantly increase the risk despite the existence of the other controls.
- Prevents **more than one** cause leading to a loss of control event or mitigates more than one consequence. Or is across multiple bowties.
- It is **independent** of other controls to perform its intended function.

ACARP C23007 Selection and optimisation of risk controls

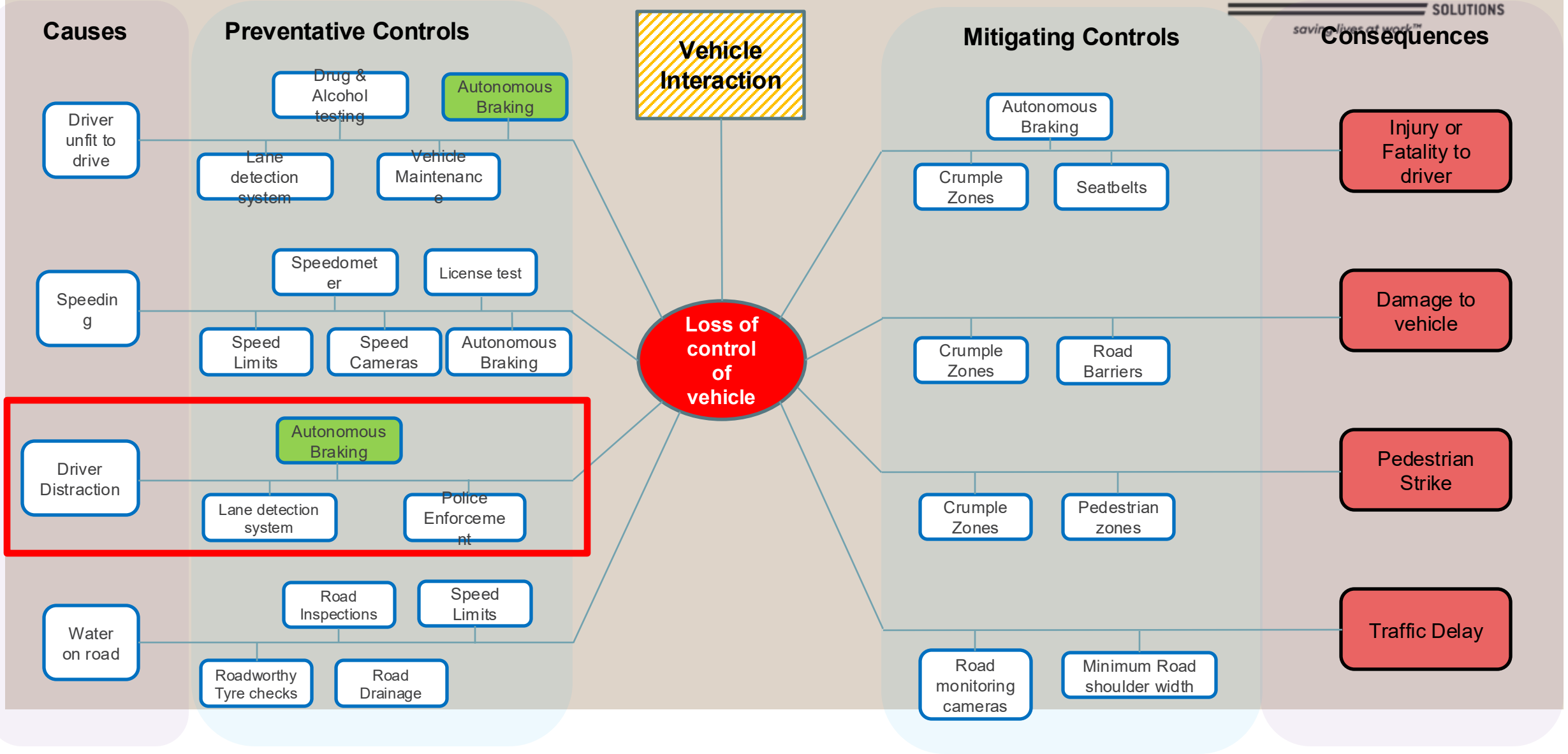
Criticality Test



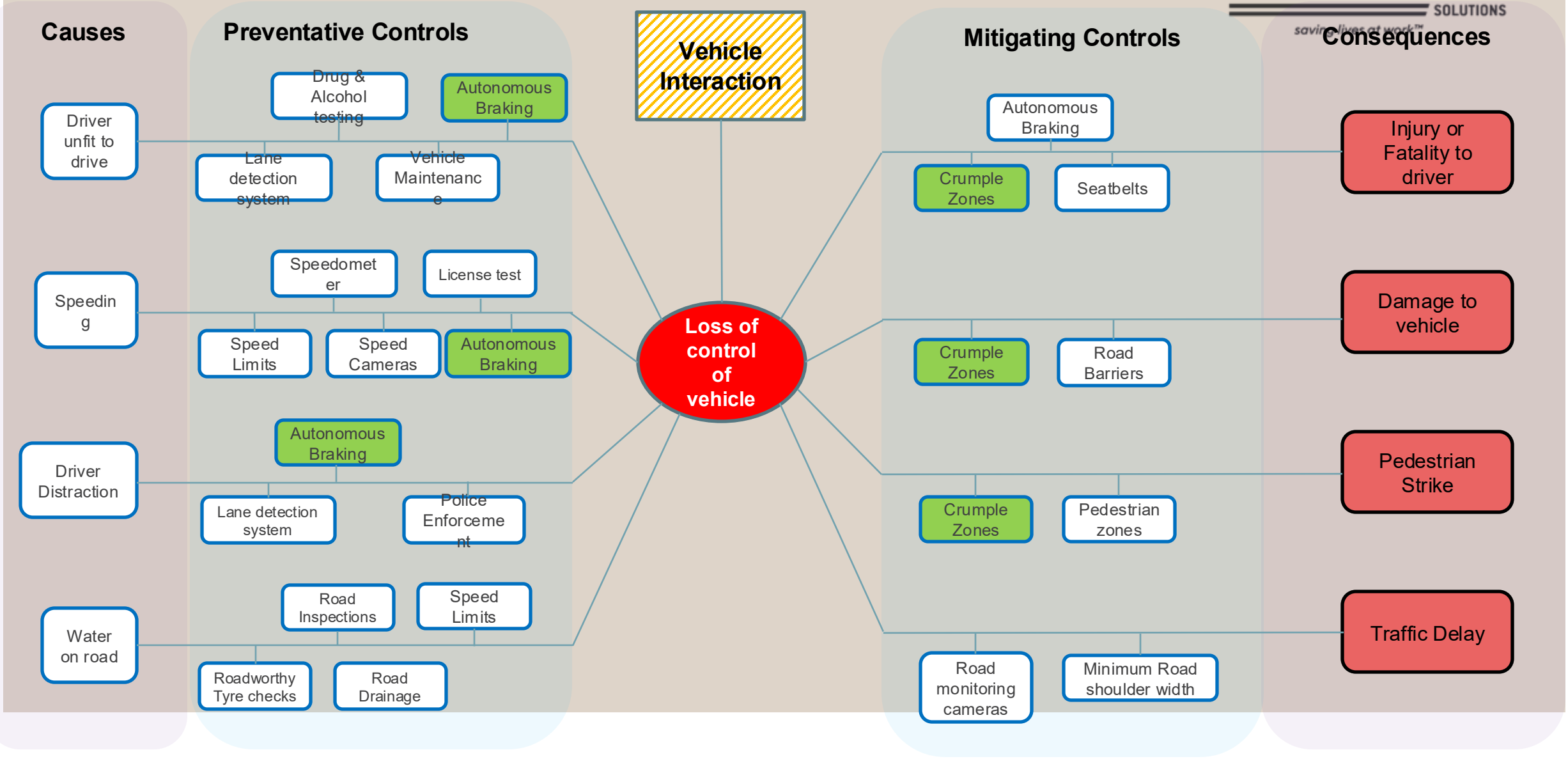
Singularity Test



Absence / Failure Test



Occurrence Test



Critical Control eligibility selection flowchart

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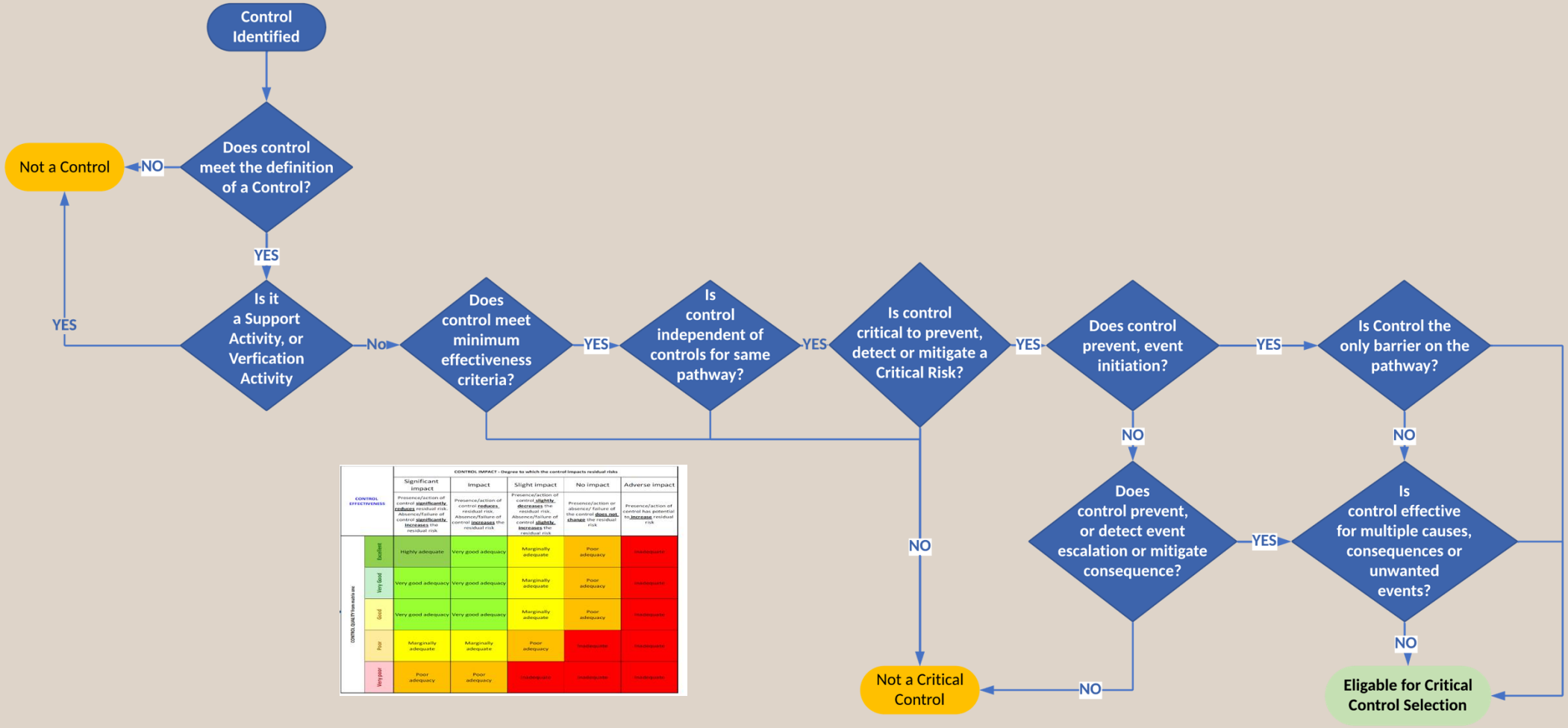
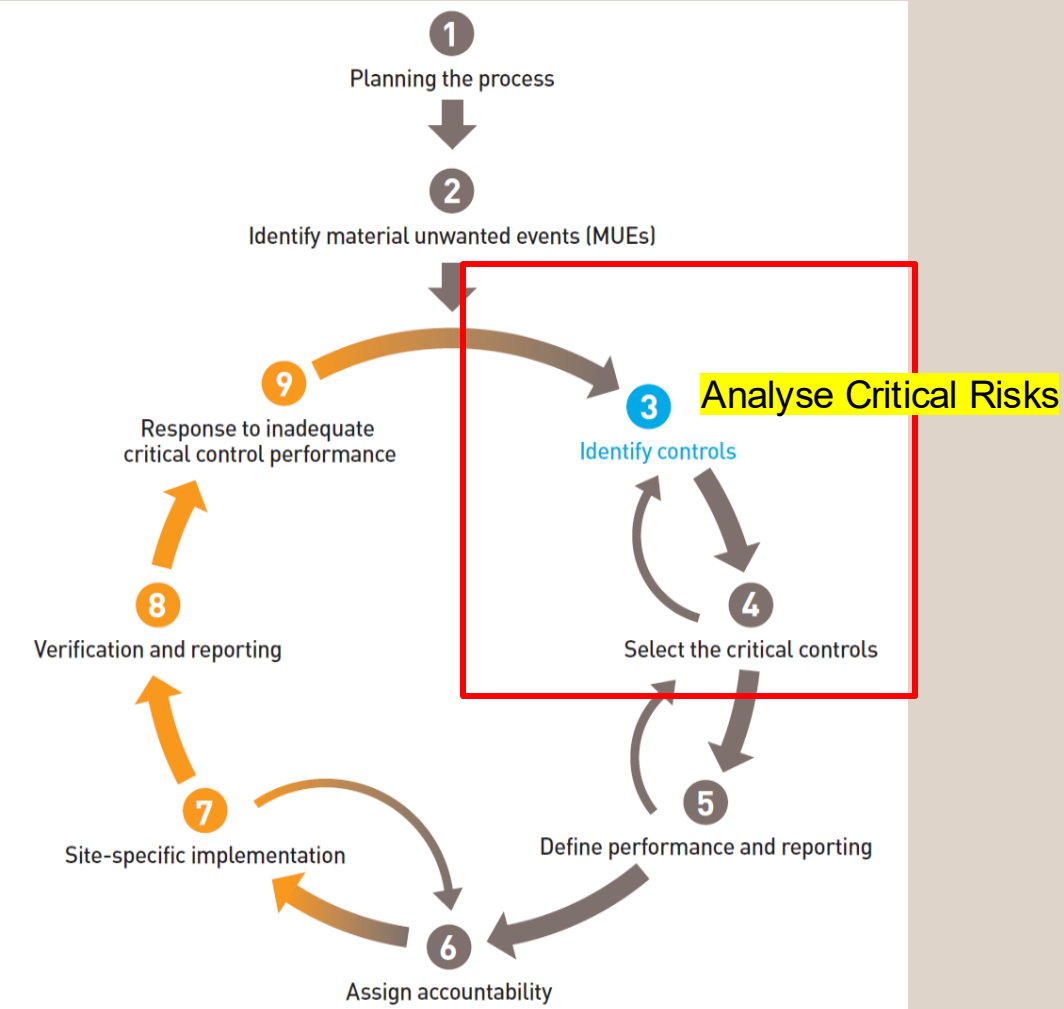
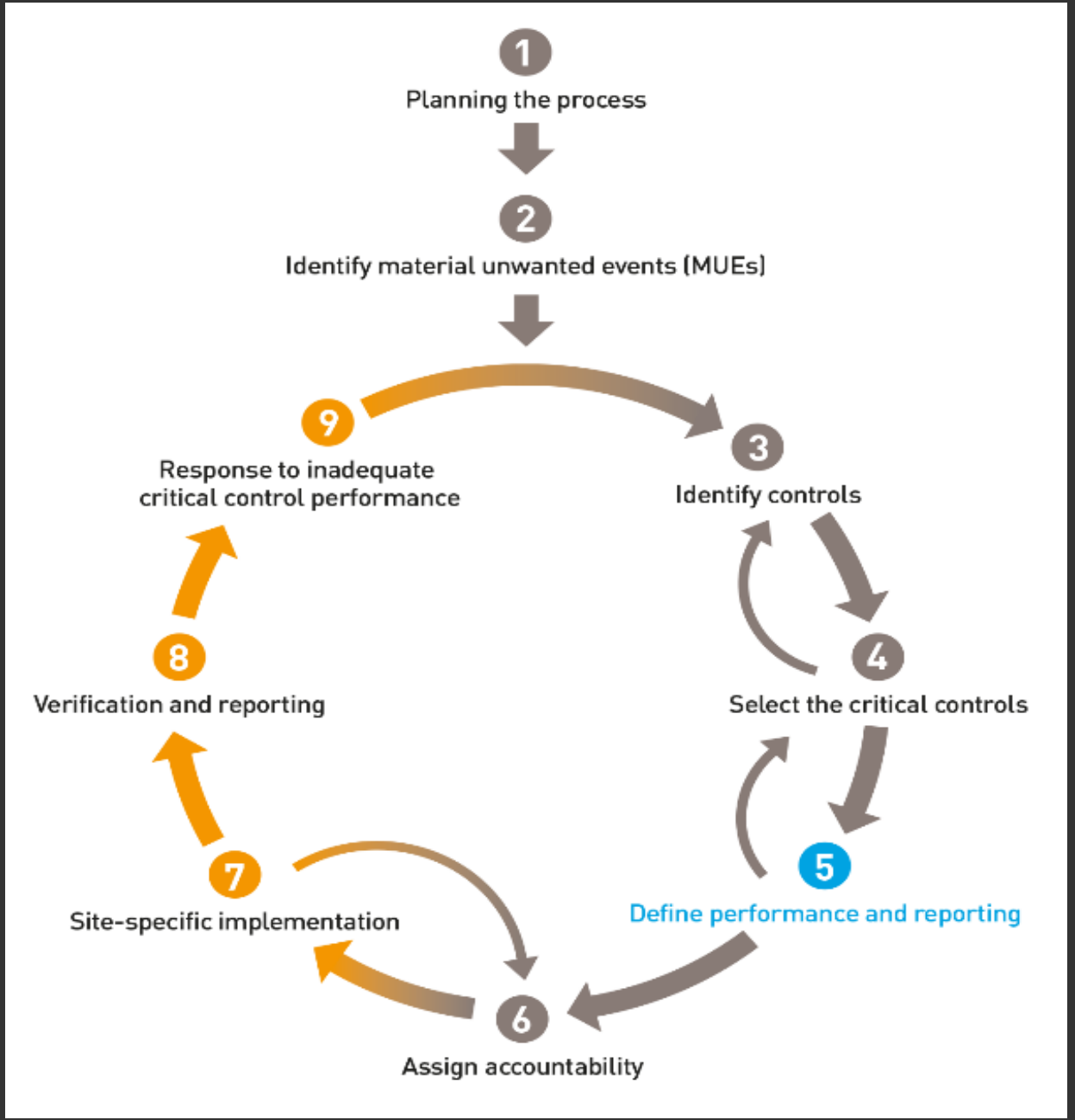


Analyse Critical Risks

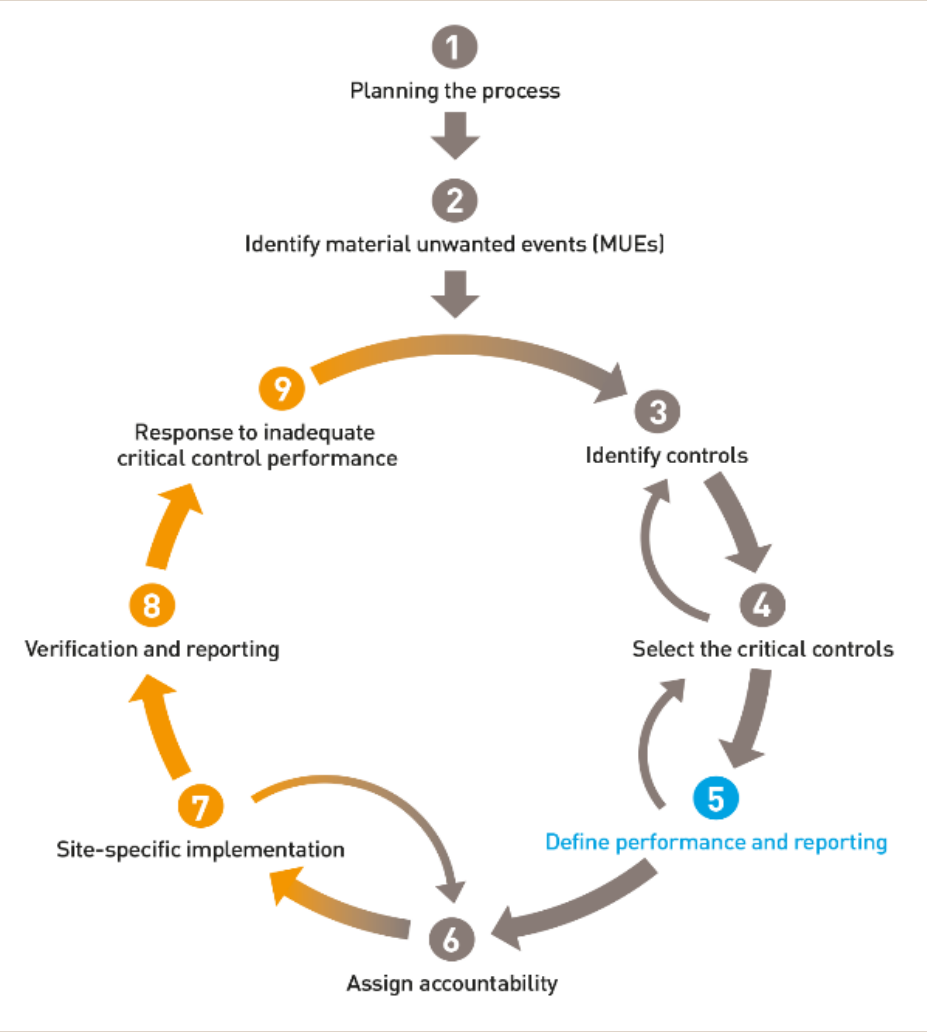


- Desired outcome:
  - A Risk Analysis is performed of each Critical Risk
- What good looks like?
  - 1 Bowtie per Critical Risk.
  - Controls are SMART.
  - Effectiveness Assessment of each Control.
  - Critical Controls identified via a selection flowchart.
  - Critical Control Failure modes and prevention strategies identified.
  - Critical Control Owners identified
- How does your business perform?

Define Performance and Reporting



Define Performance Requirements



Desired outcome:

- Define the required performance of each Critical Control on aspects such as;
  - Activities that ensure Critical Control Operation
  - Ownership
  - Training
  - Failure Modes
  - Performance Triggers
  - Verification Strategies

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Critical Control Performance Standards

Performance Standards

- Who’s familiar with Performance Standards?
- What are they?
- What do they do?

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Critical Control Verification Process Design

Verification Process Design

Critical Control Verification Activities

- Performance Requirements
- Performance Triggers and Action Response
- Failure Mechanisms and prevention strategies
- Competency Requirements
- Lifecycle Requirements

Verification Vs Supervision

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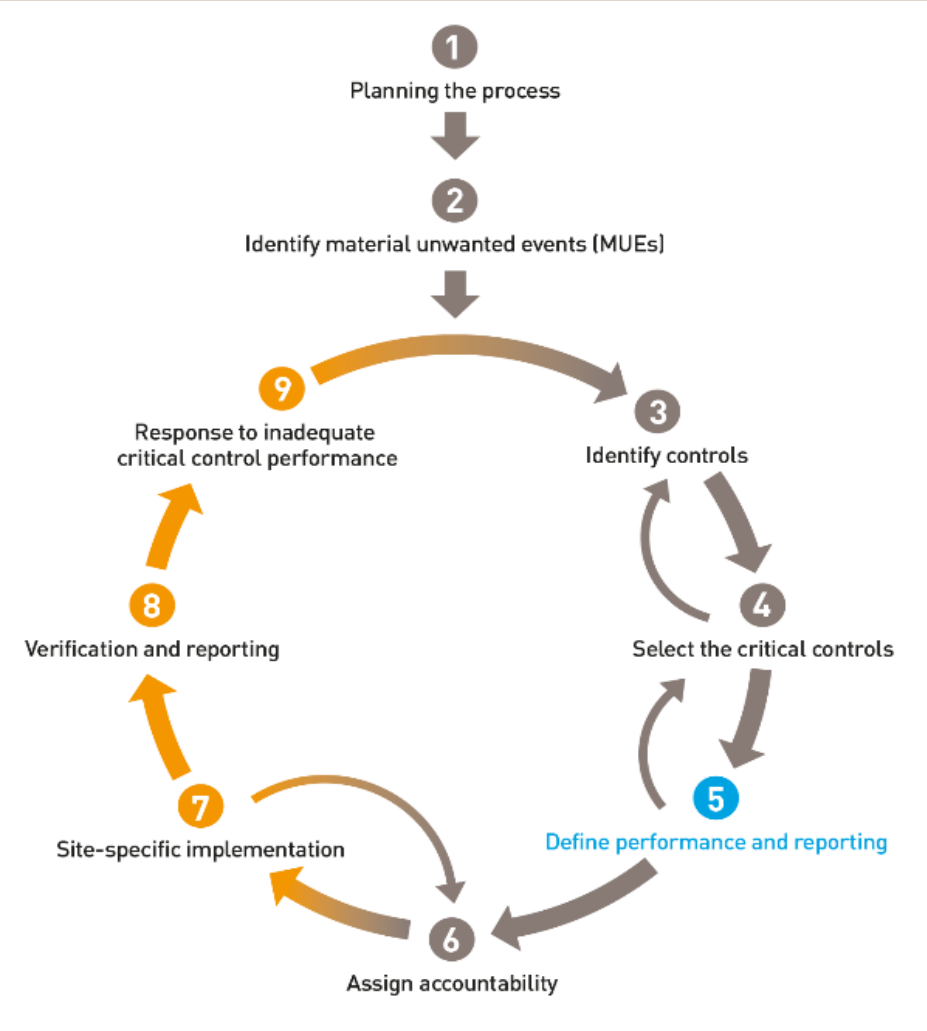
Verification Activities **should not** duplicate Layer 1, 2 or 3 checks

Element	Layer 1: Worker	Layer 2: Supervisor (Planning)	Layer 2: Supervisor (Plan Validation)	Layer 3: Audit, VFL's, Safety Ob's, Line Mgmt. checks	Layer 4: Critical Control Verification
Work Environment	Check prior to and during task	Check prior to worker entering area	Confirm worker checks Sample during task	Sample management of work environment	Sample supporting Management Systems
Procedures, Permits, forms, etc..	Follow procedural requirements	Make available, confirm worker understanding of requirements	Confirm worker following requirements	Sample understanding of and compliance to procedures	
Equipment (machinery, PPE, tools, etc..)	Check before task, use correctly during task	Organise Equipment	Confirm planned equipment is available and used correctly	Sample equipment management, operation, and availability	
Competencies, authorisations, etc..	Self check competent to perform task	Assign competent persons to work tasks	Confirm assigned worker is performing task	Sample competencies, authorisations compliance to task requirements	
Work as done vs work as intended gap	Identify and escalate		Manage or escalate	Identify and escalate	

Verification Activities should check **the system** for managing Work Environment, Procedures, Equipment, Competencies, Task Variation

Define Performance Requirements



- Desired outcome:
  - Defined Critical Control Performance
- What good looks like?
  - 1x Performance Standard for each Critical Control.
  - Each Performance Standard covers the essential elements.
  - Critical Control Verification Strategies documented
- How does your business perform?

Performance standards are not enough!!!

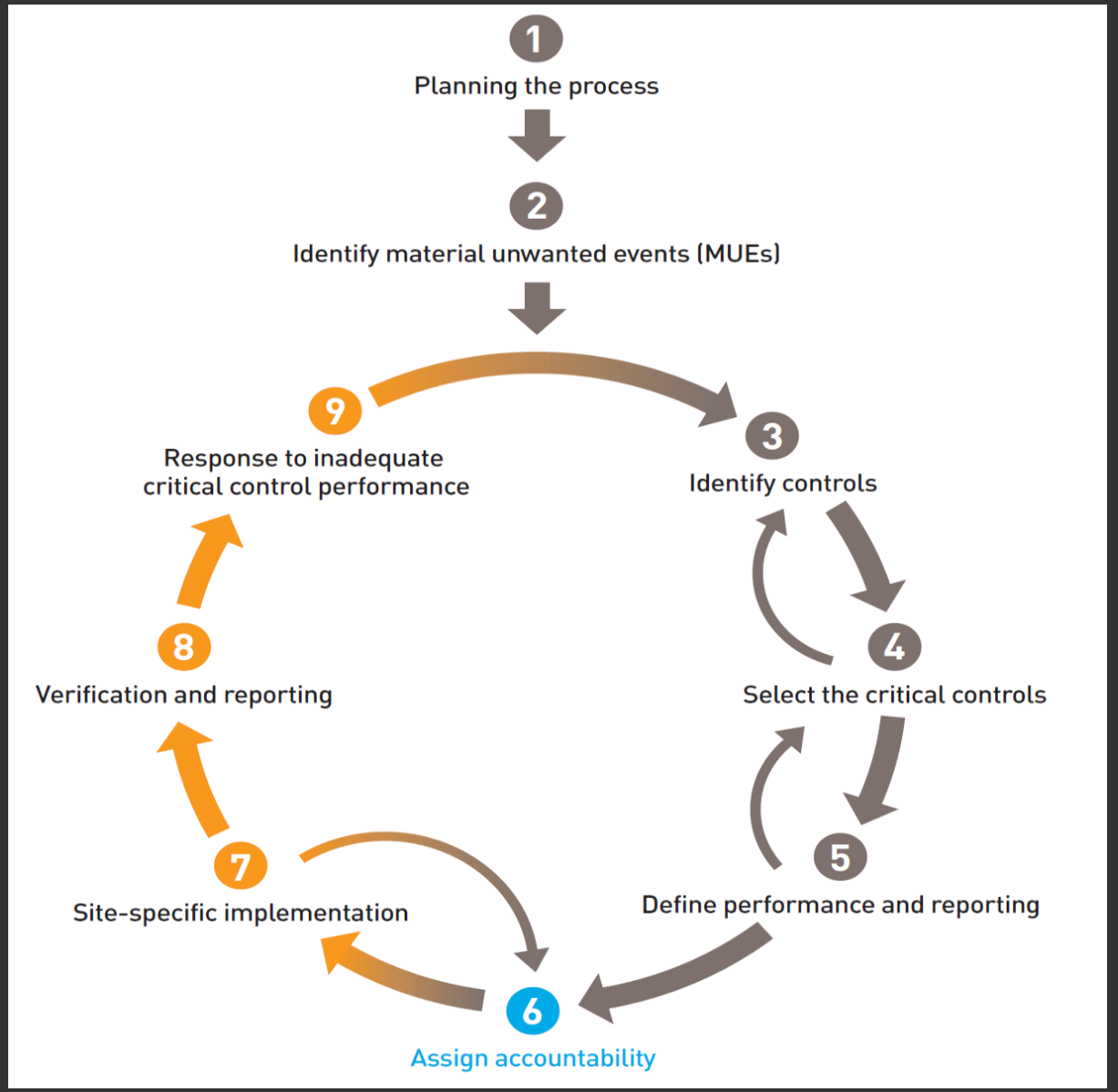
industry? This study analyzed 10 years of serious and fatal incident investigation reports from four international construction companies to (i) assess the reliability of their Critical Controls (CCs) and (ii) assess the factors that affect the reliability of CCs. The results show the reliability of CCs, measured by implementation and effectiveness, averaged just 42%. Insight into human performance

Source - Selleck, R.; Hassall, M.; Cattani, M. Determining the Reliability of Critical Controls in Construction Projects. Safety 2022, 8, 64.

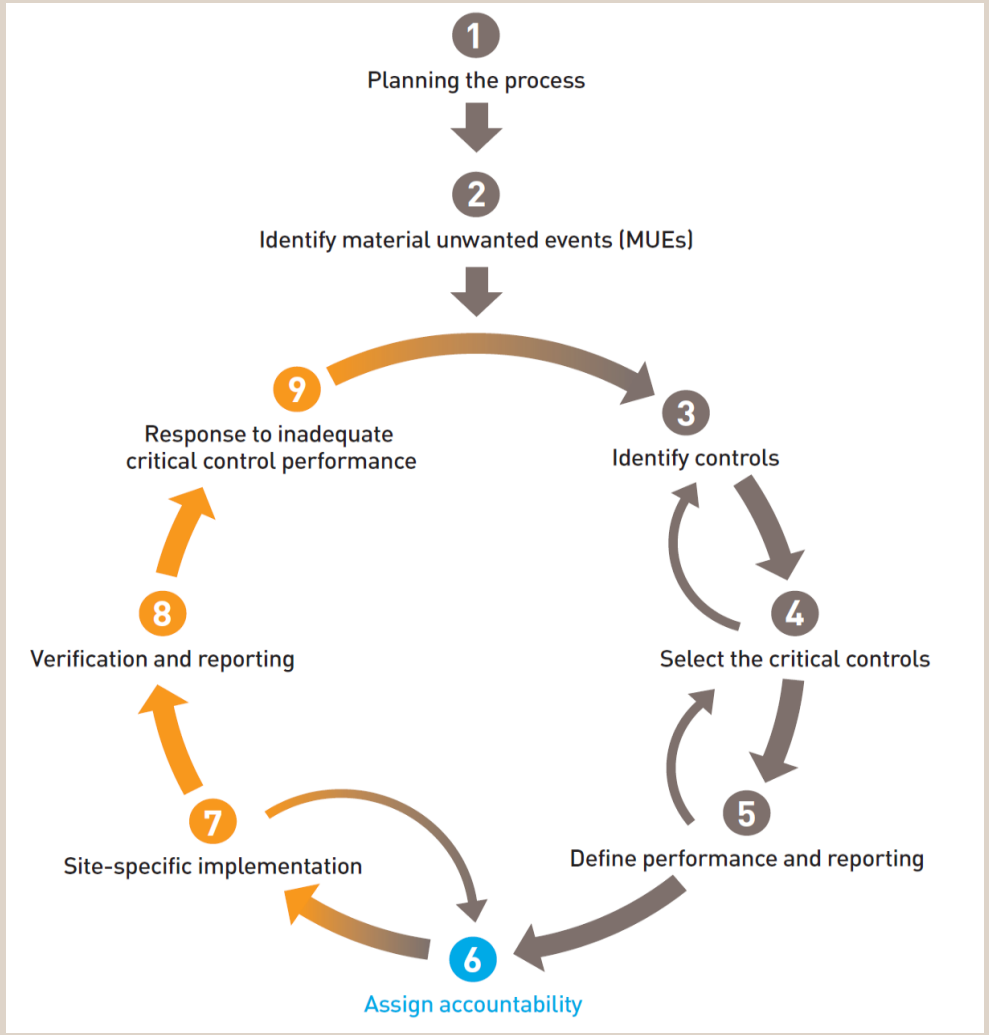
critical controls were assumed to be operating effectively. Unfortunately, there was plenty of other evidence that these controls were *not* operating effectively, specifically large numbers of exceedances, but this was not regarded as relevant. What appears to have happened was that the monitoring of critical controls was treated as routine bureaucratic process and, provided this yielded satisfactory results, nothing else seemed to matter.

Source – Andrew Hopkins | March 2023 | Managing the Risk of Major Accidents – Lessons from Anglo American's Grosvenor mine accident

Assign Accountability

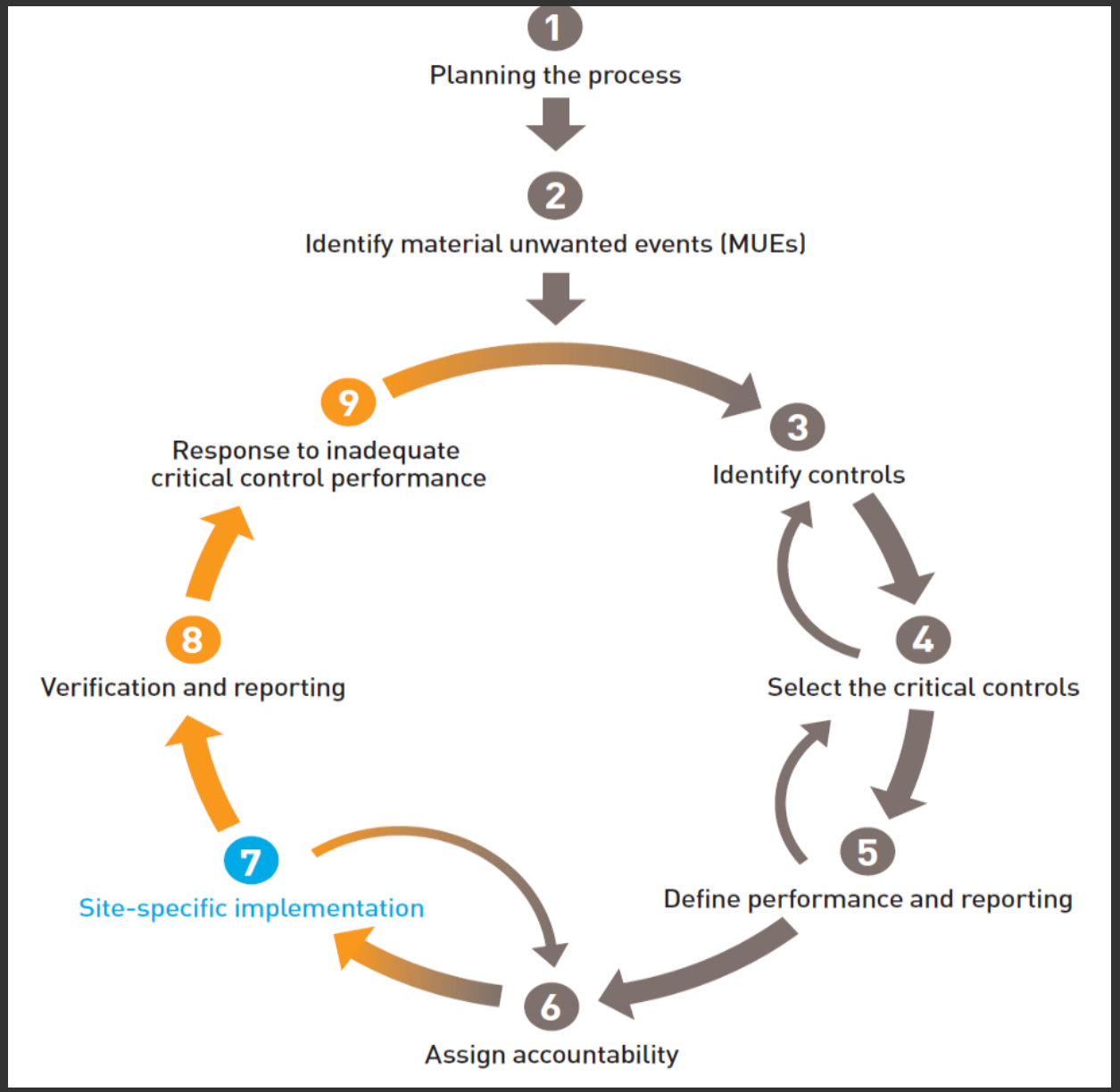


Assign Accountability



- Desired outcome:
  - Owners identified for CRM System, Critical Risks, Critical Controls, Verification Strategies.
- What good looks like?
  - Formal appointments of CRM System Owner, Risk Owners and Critical Control Owners, Verifiers (potentially).
  - Training for key roles mapped into Training Needs Analysis
- How does your business perform?

Site Implementation



Integration of Critical Controls into SHMS

- Question - How will the front-line worker know about Critical Controls associated with the activity they will are about to perform?

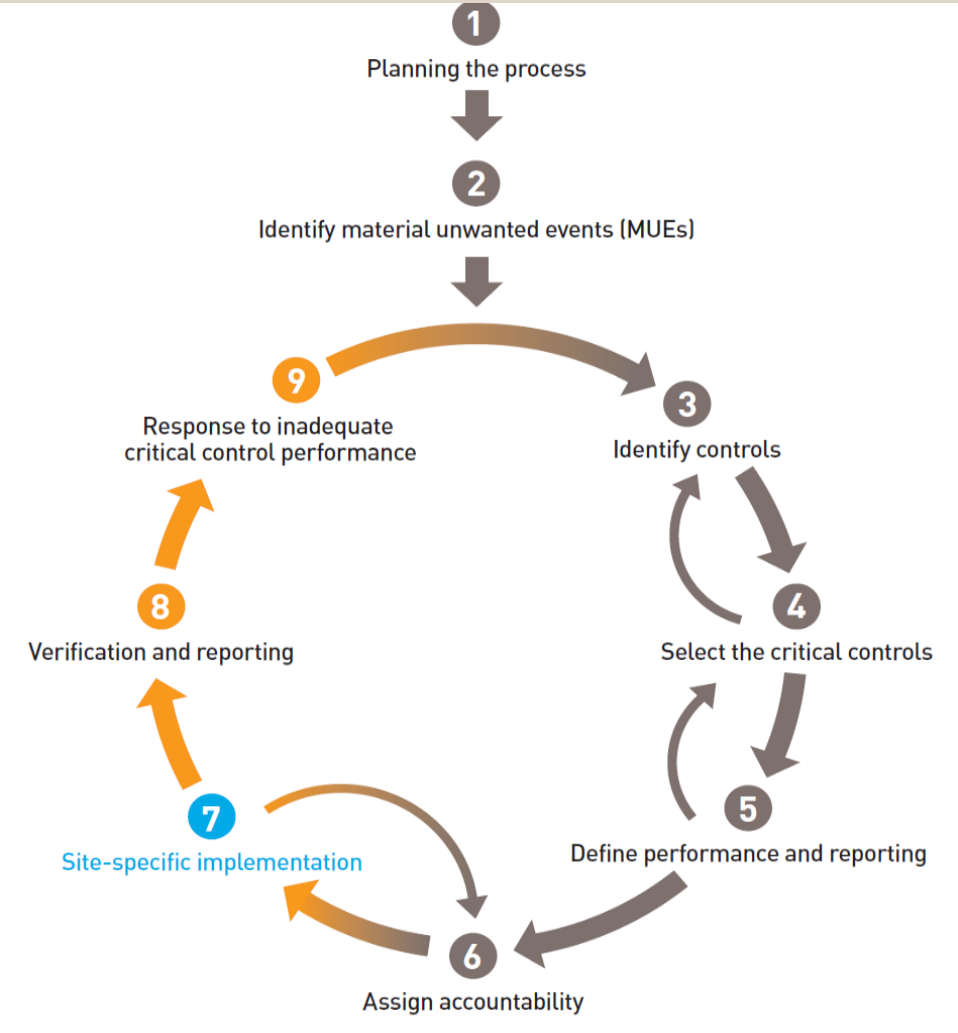
- And – Can they explain how the Critical Control will prevent a fatality?

Integration of Critical Controls into SHMS

Possible options:

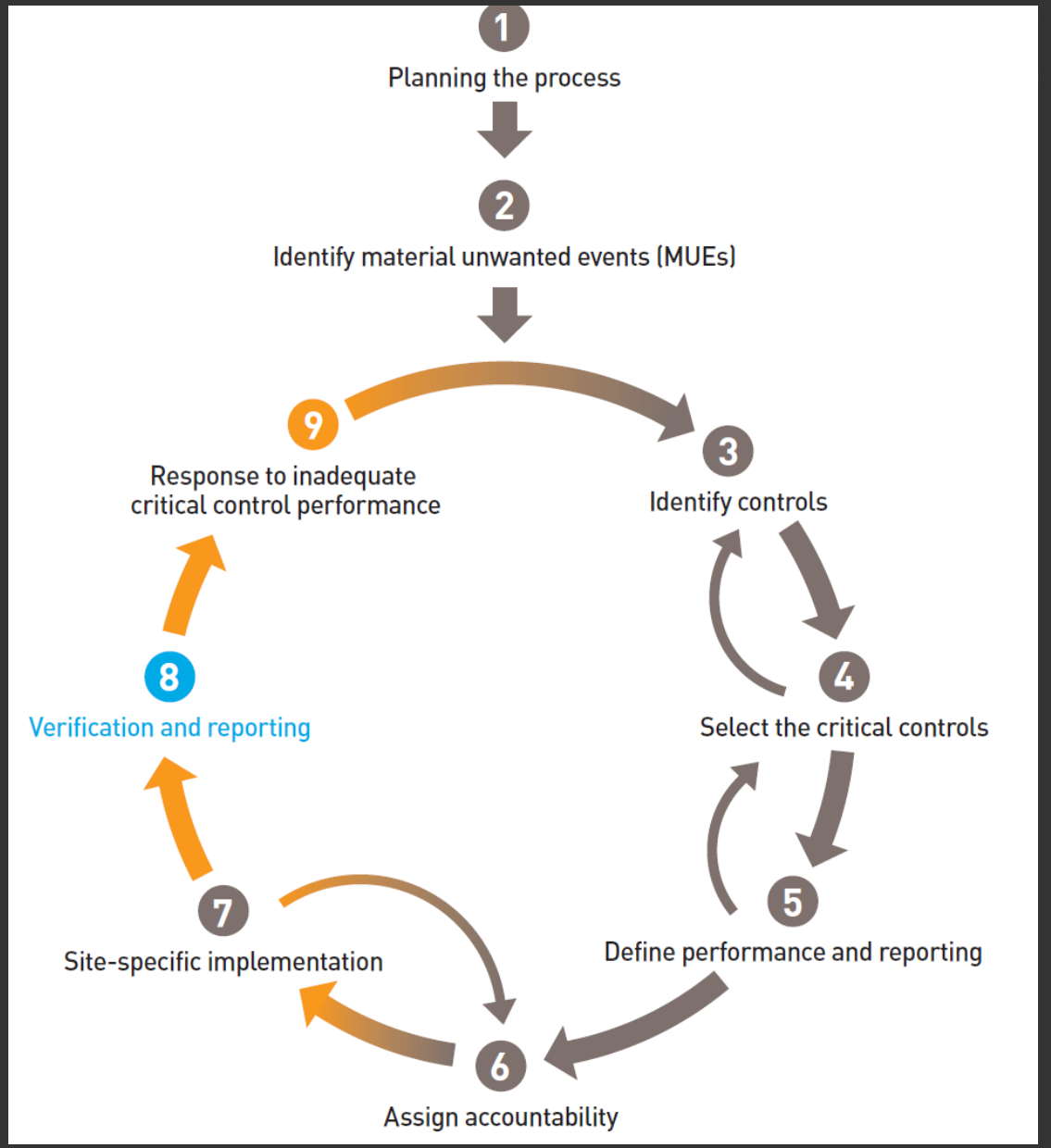
- Add to Standard Operating Procedures
- Add to Principal Hazard Management Plans
- Add to Pre-task risk assessment prompts
- Add to Job Safety Analysis Prompts
- Work Planning Process
- Pre-shift Meeting scope
- Others?

Site Implementation



- Desired outcome:
  - Implement CRM Process.
  - Implement actions from upstream activities
- What good looks like?
  - All actions from BBRA and Bowties implemented.
  - Verification programs scheduled in system.
  - Safety and Health Management System documents created.
  - Training provided to key stakeholders (Risk Owner, Control Owner, Frontline worker)
- How does your business perform?

Verification and Reporting



Summary Risk Report

Critical Risk	Rating	Comment
Surface Fire		
Underground Fire		
Falling from Height		Verifications identified deficiencies in Working at Height Permits
Lifting Failure		
Confined Space		
Contact with live electrical Conductors		
Loss of Control of Vehicle		Verifications identified deficiencies in proximity Detection Critical Control
Exposure to Hazardous Substances		
Tyre / Rim Failure		
Uncontrolled Release of Energy		HPI – Fluid Injection Incident
Unintended Detonation of Explosives		
Dropped Objects		

Risk Specific – Critical Control Report

Example Report for Loss of Control of Vehicle

Critical Control	Rating	Comment
All mobile plant is compliant to site standard		
Bunds installed on all roadways		
Proximity Detection		Verifications identified deficiencies in proximity Detection Critical Control
Emergency Response Plan		

Critical Control Report

Example report for Proximity Detection

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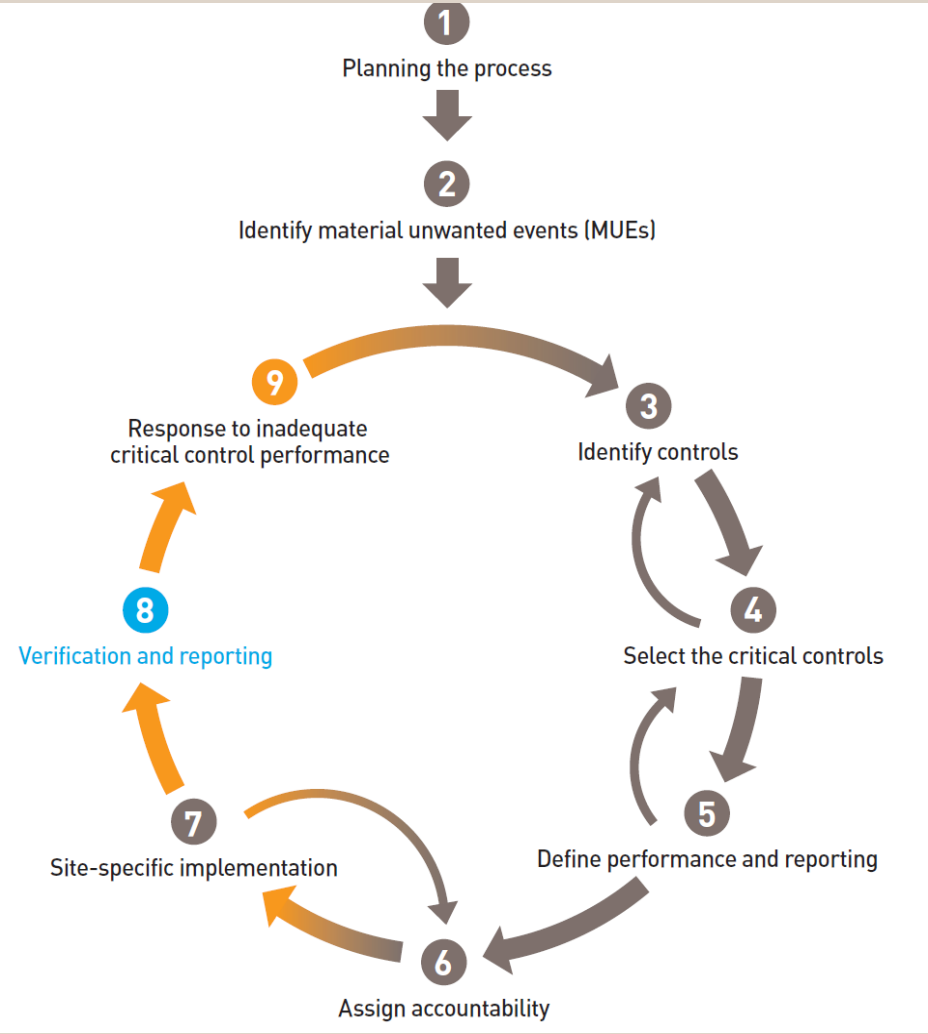
Performance Parameter	Verification Frequency	Rating	Comment	Action
Design	Annual			
Functionality	Quarterly			
Timing	Quarterly		System not detecting consistently.	Consultant on site to investigate
Availability	Quarterly			
Reliability	Quarterly			
Dependency	Quarterly			
Training & Competency	Bi-Annually		Not all Supervisors trained in updated Traffic Management Plan	Retraining started.
Performance Triggers	Quarterly			
Failure modes	Quarterly			

Summary Critical Control Report

Critical Control	Rating	Comment
Isolation and Lockout		
Access Control		
Work at Heights Permit		Verifications identified deficiencies in Working at Height Permits
Engineering Design of Embankment, Slopes, and Dam Walls		
Flotation Devices		
Open edge protection		
Proximity Detection		System not detecting consistently.
Hazardous Substances approvals (High Risk/Red Chemicals)		
Insulation and Enclosure of Live Parts		
Overhead Structures Identification		HPI – gantry crane failure
Certified Equipment Supports		
Lightning Protection System		

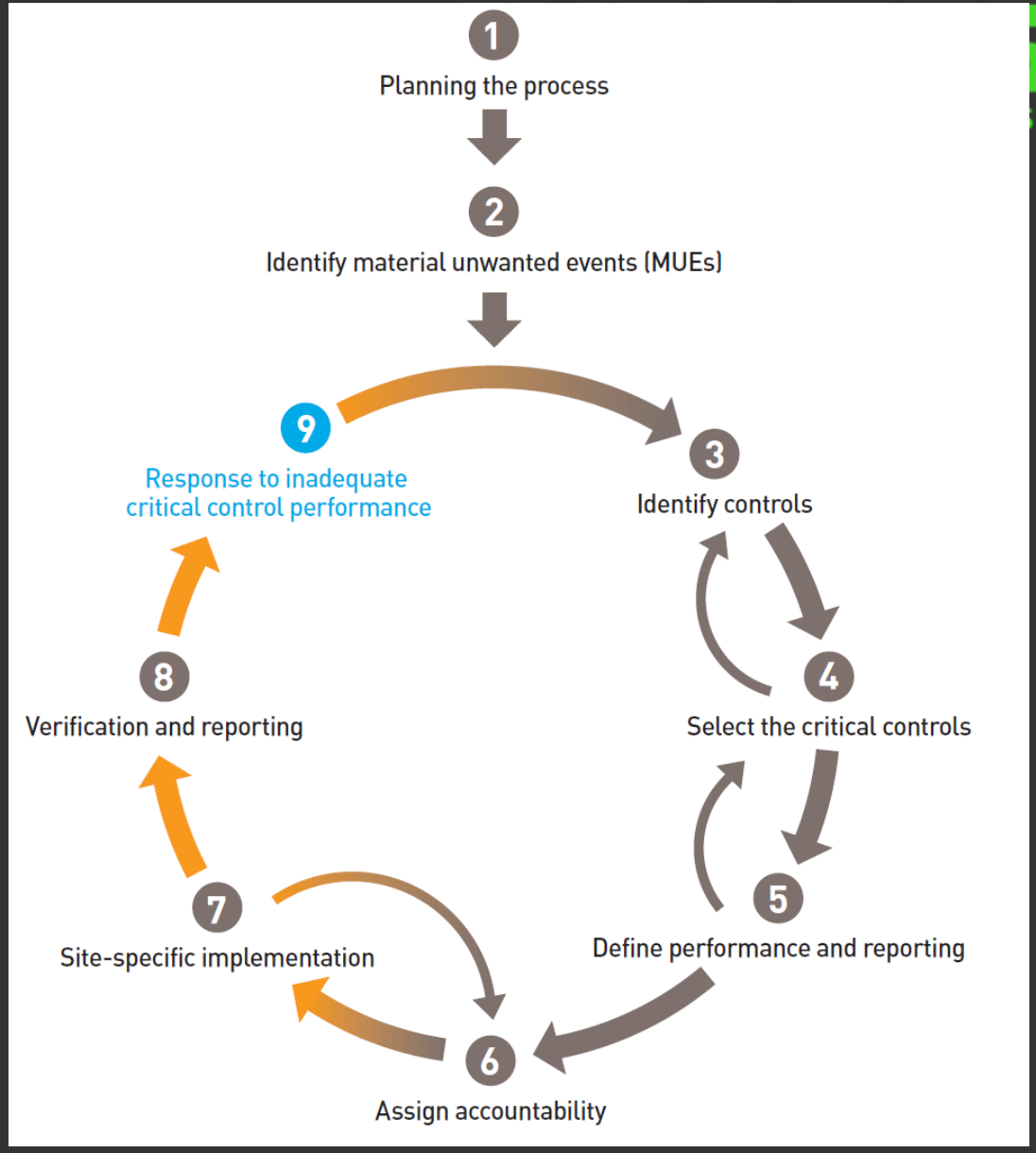
Does ‘amber’ add any value?

Verification and Reporting

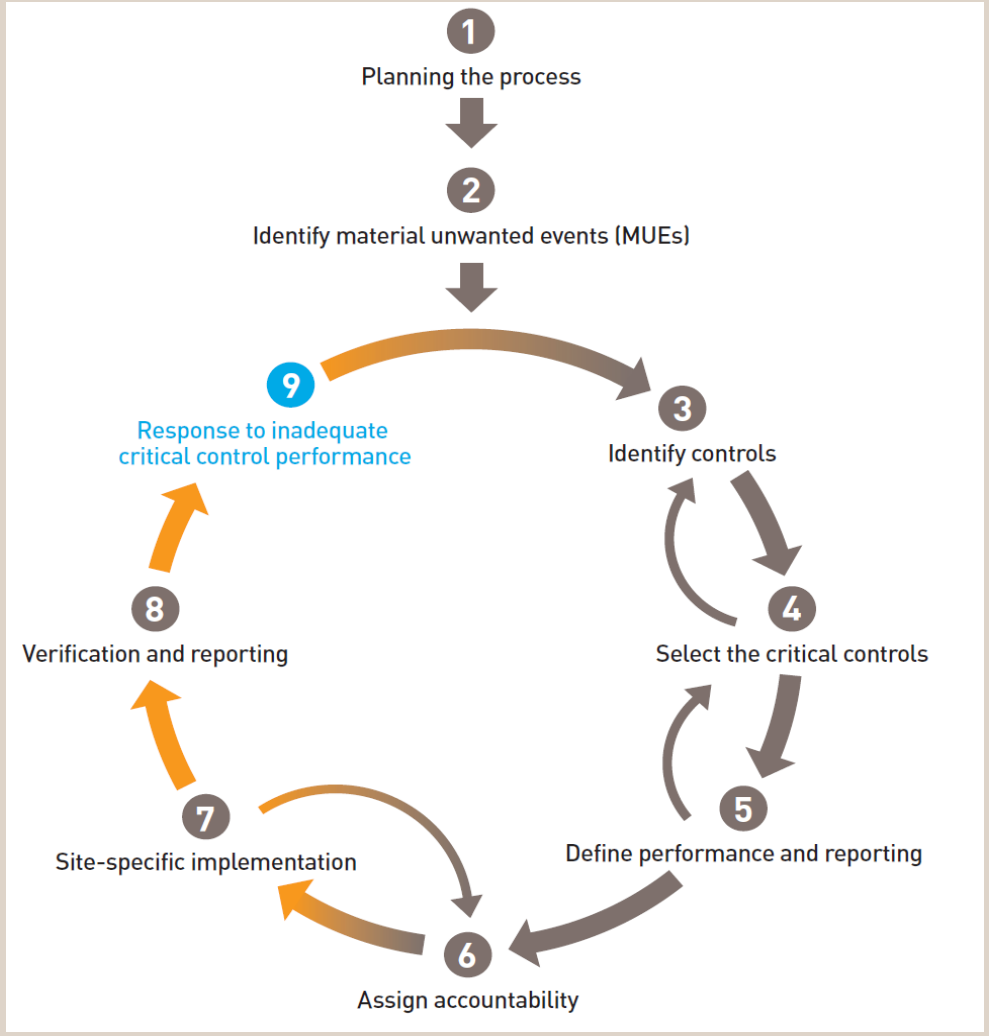


- Desired outcome:
  - Implement verification activities
  - Report on process, risks and controls.
- What good looks like?
  - Metrics and KPIs implemented for CRM process.
  - Verification activities completed in accordance to schedule and evidence provided.
  - Critical Control failures fixed, reported as an incident (and seen as a good thing)
- How does your business perform?

Response to inadequate critical control performance

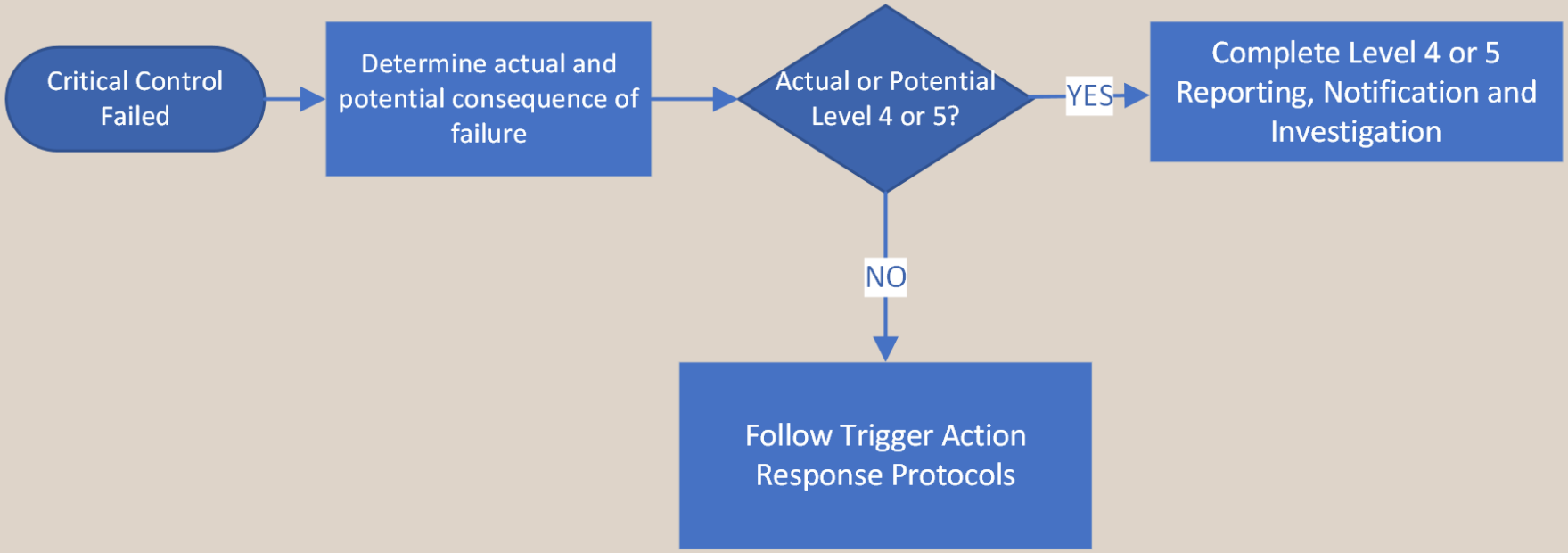


Response to Inadequate Performance



- Desired outcome:
  - Critical control and Risk owners are aware of critical control performance.
  - Critical Control Failures are investigated, and improvement actions implemented.

Control Failure Assessment process



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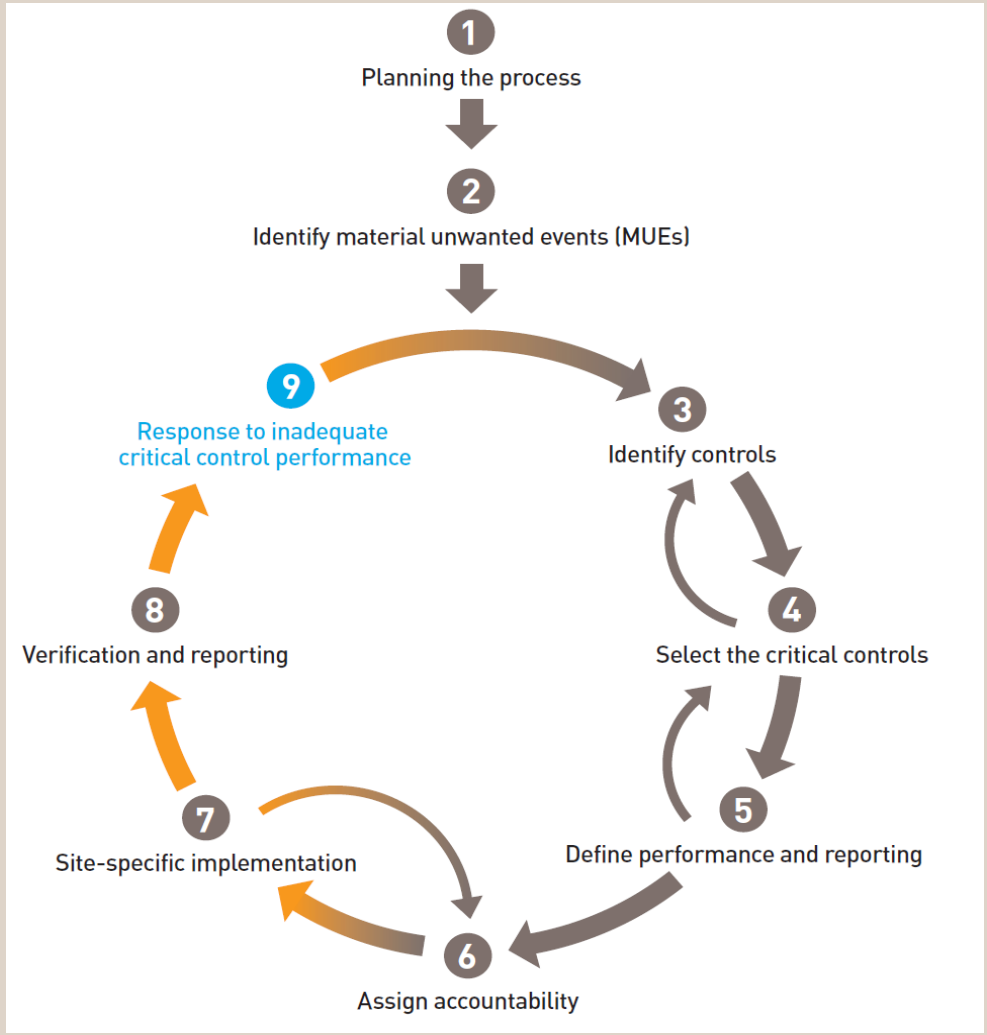

- Desired outcome:
  - Critical control and Risk owners are aware of critical control performance.
  - Critical Control Failures are investigated, and improvement actions implemented.
- What good looks like?
  - Control failure assessment process defined
  - Incident Investigation process includes consideration of Critical Controls.
  - CRM Deliverables are updated based on findings from Investigations (e.g. Bowtie, BBRA, Performance Standard)
- How does your business perform?

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Framework Review

CRM Framework

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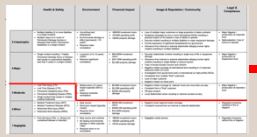
Incident Investigations

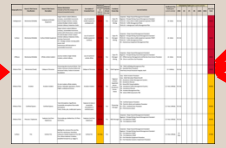
New Actions and Work Orders

Implementation Plan

Materiality Criteria



Broad Brush RA

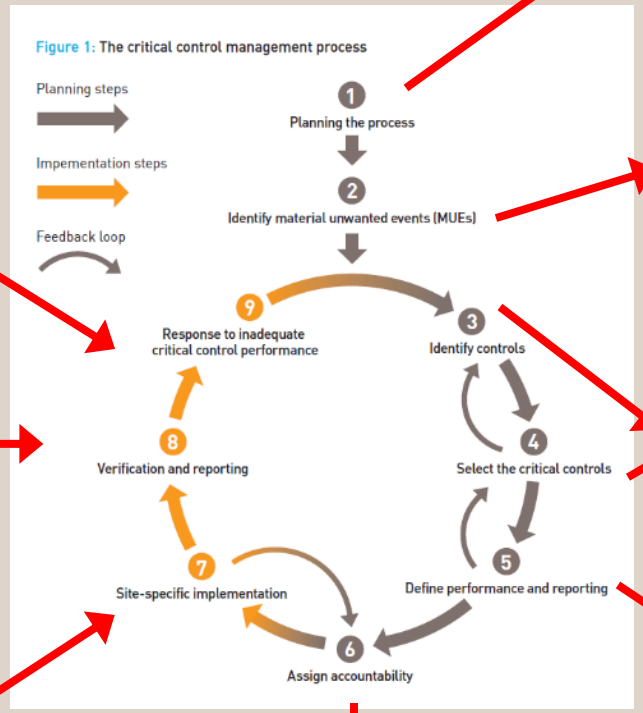


Critical Risks

Risk Treatment Plans

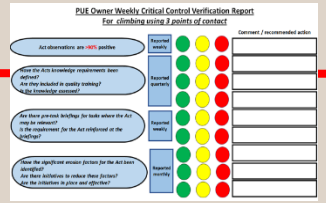
Hazard Description

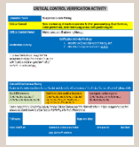
Risk Register



Reporting

Critical Control Verifications





Bowtie Analysis

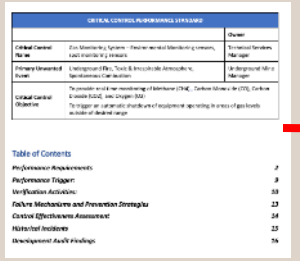
Controls

Control Effectiveness Assessment

Critical Control Flowchart

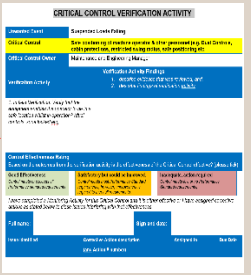
Critical Controls

Performance Standard



Sampling Methodology

Verification Sheet



Completed Actions and Work Orders

Job Planning & Execution

Change Management Workforce Training

Action Management System, Work Management System

Control / Risk Owner Appointment Forms

‘Ah hah’ moments

Where to start?

CRM Framework

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Incident Investigations

New Actions and Work Orders

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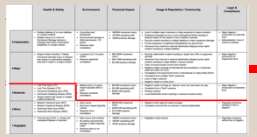

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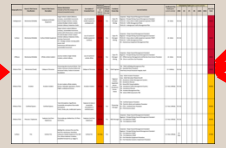

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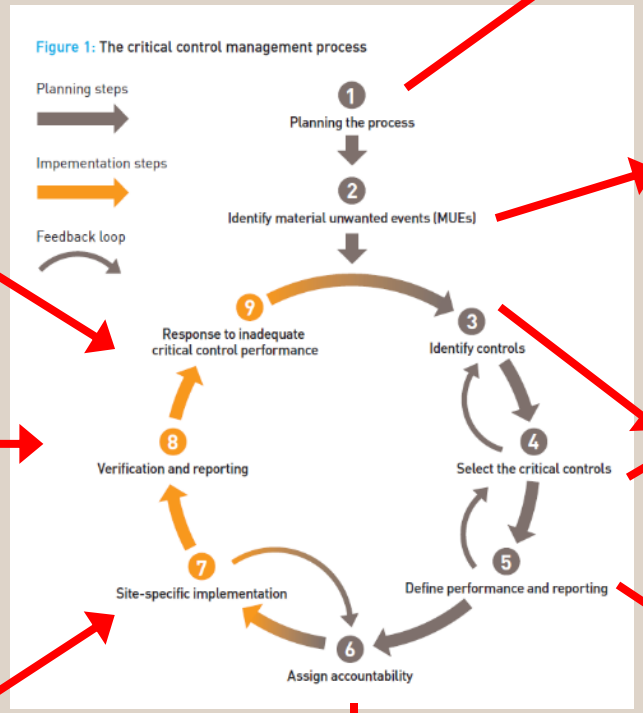
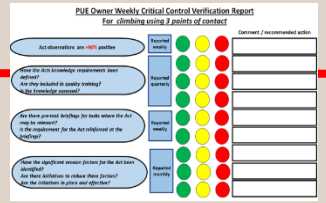
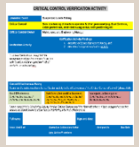


Reporting

Critical Control Verifications





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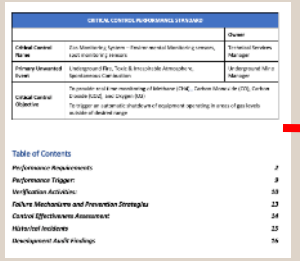

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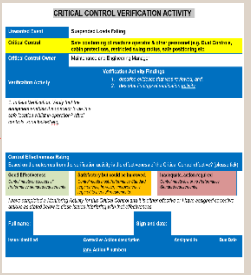

Completed Actions and Work Orders

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Where to start

CRM Implementation step	Indicative duration (days)	Comment on duration
CRM planning		
Planning Workshop (prep, execute, close out)	3	
Project Plan completion	1	
Development / Modification of CRM related templates (BBRA, Bowtie, Performance Standard, MUE Owner / Critical Control Owner Authorisation forms, Critical Control Verification Sheets, Incident Investigation, PHMP, SOP, WRAC)	TBD	Dependent on number of templates to be created / modifiied to be created / updated, and nature of the change. Estimate average of 2 hours per template.
MUE Identification		
Broad Brush Risk Assessment (prep, execute, close out)	5	2 days prepation, 2 days facilitation, 1 day completion - for large high hazard organisations
MUE Hazard description document [one per MUE]	TBD	Total duration dependent on numbers of MUEs. Estimated average of .5 days per document
MUE Analysis		
Bowtie Analysis (prep, execute, close out) [one per MUE]	4	Total duration will be dependent on numbers of MUEs
Define Performance and Reporting | Assign Accountability		
Critical Control Performance Standards [one per Critical Control]	0.5	Total duration will be dependent on numbers of Critical Controls Estimated average of 5 days per Performance Standard
Critical Control Verification Sheets [multiple per Critical Control]	0.1	Total duration will be dependent on numbers of verification sheets required for each Critical Control. If the performance standard has been completed in full this activity should not take much time
CRM reporting [reporting strategy, reports]	5	Dependent on method for calculation and process for calculation (e.g. manual, vs automated system)
CRM Implementation		
Change Management Workshop (prep, execute, close out)	3	
Appoint MUE Owners and Critical Control Owners	TBD	Depependent on number of MUEs and Critical Controls. Estimated at 30 mins per form
SHMS document creation / update (PHMPs, SOPs, MPs, Forms)	TBD	Dependent on number of SHMS documents to be created / updated, and nature of the change
Creation of recurring tasks in work management system	TBD	Dependent on number of recurring tasks and work management system
Creation of recurring tasks in action management system	TBD	Dependent on number of recurring tasks and action management system
Training (Risk Owners, Critical Control Owners, Critical Control Verifiers, workforce)	TBD	Dependent on CRM training approrach and number of peple to be trained
Specific Change Management activities	TBD	Dependent on outcomes from change management workshop

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Where to next?

Partner with us

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Do it Yourself

Do with you

Done for you

Take advantage

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Offering free 60-minute consult sessions until Saturday Morning.

Questions

If you feel you have gained value from this workshop I would welcome you sharing a few words on google

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Thankyou