Using the Operability and Maintainability Analysis Technique to understand equipment design issues

Tristan Cooke (MISHC)
Brad Pritchard (Xstrata)

Overview

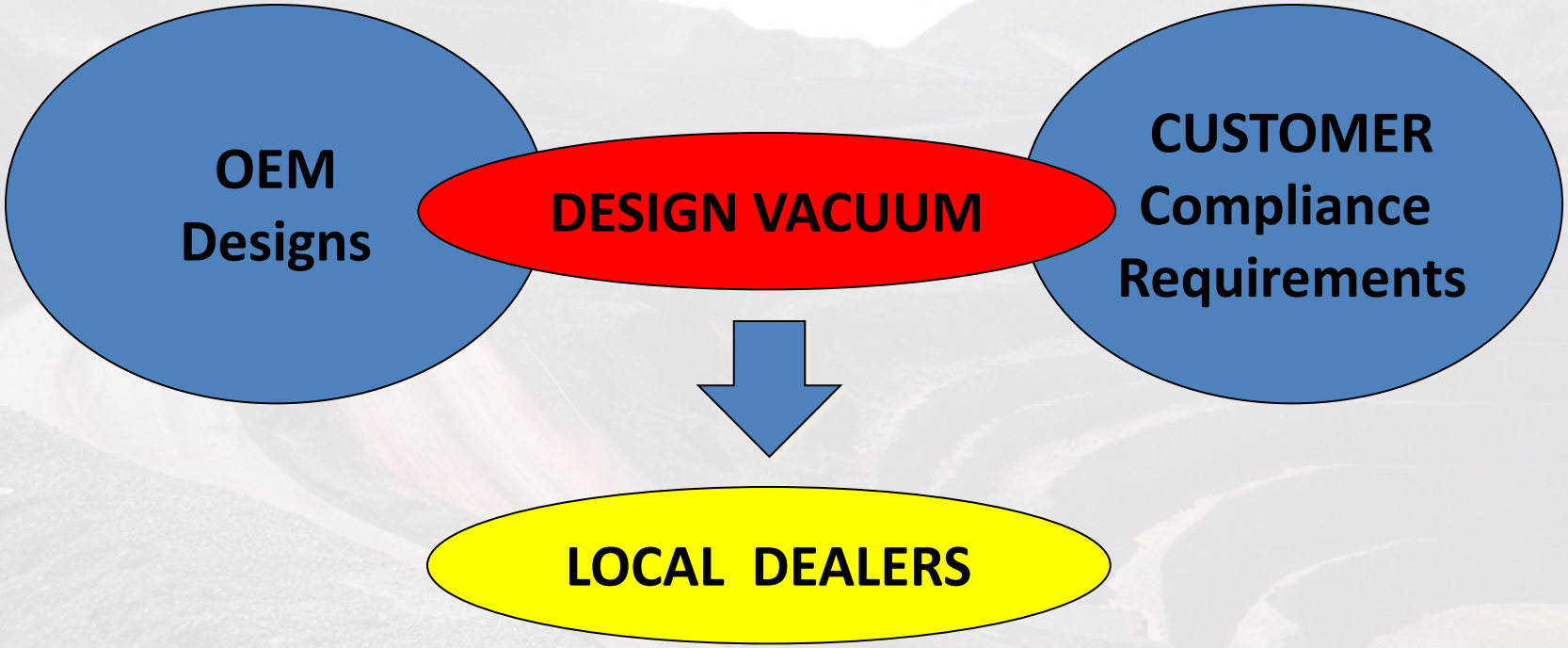
- The Background of OMAT
  - Tristan Cooke
- The use of OMAT on underground mining equipment to identify the relationship of manual tasks risk to design.
  - Brad Pritchard

EMESRT

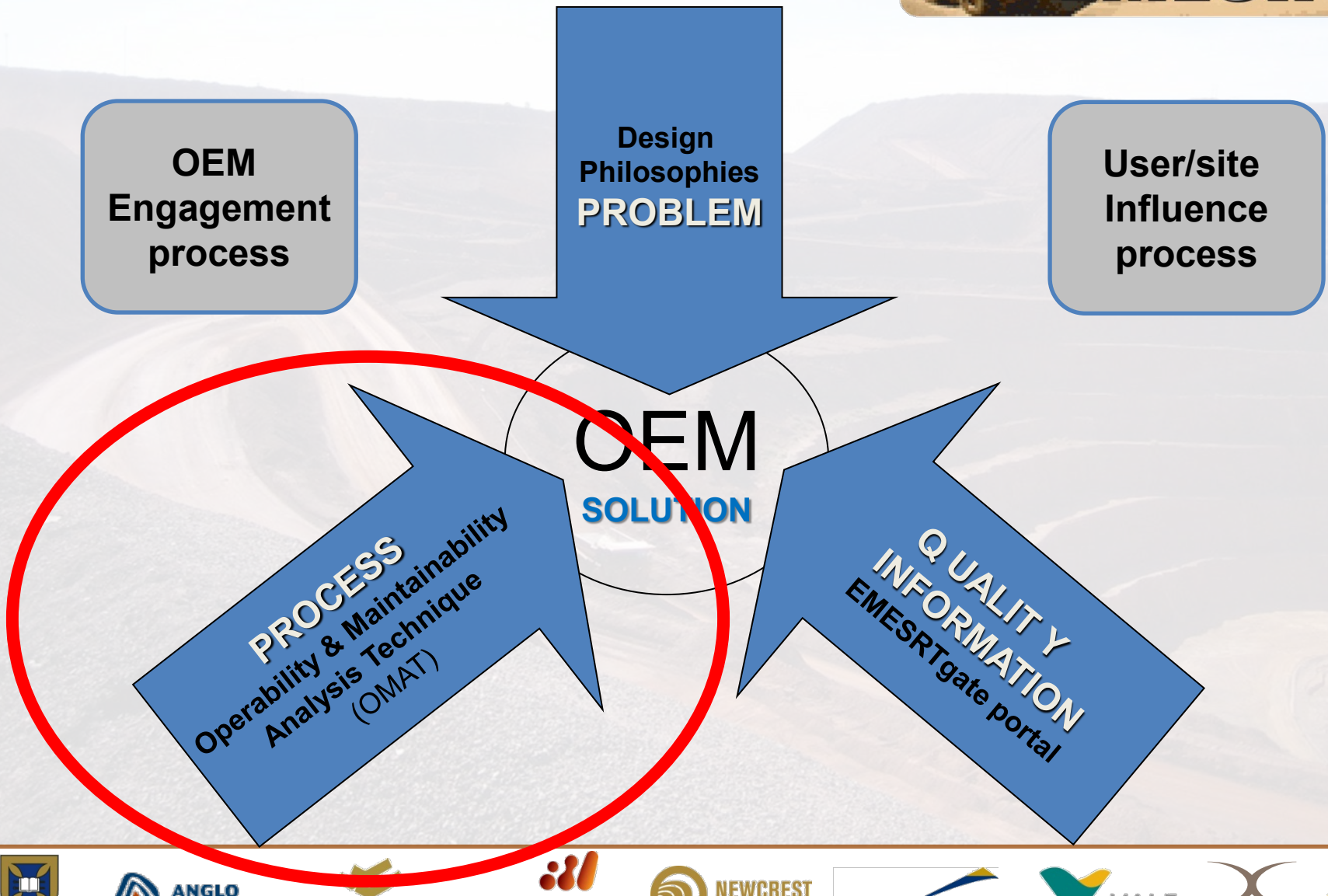
2009

A new approach

.....to accelerate development and adoption of leading practice designs for exploration and mining equipment to minimise the risk to Health and Safety **through a process of** Original Equipment Manufacturers (OEM), contractors and end user **engagement**


OEM
Designs
DESIGN VACUUM
CUSTOMER
Compliance
Requirements
LOCAL DEALERS

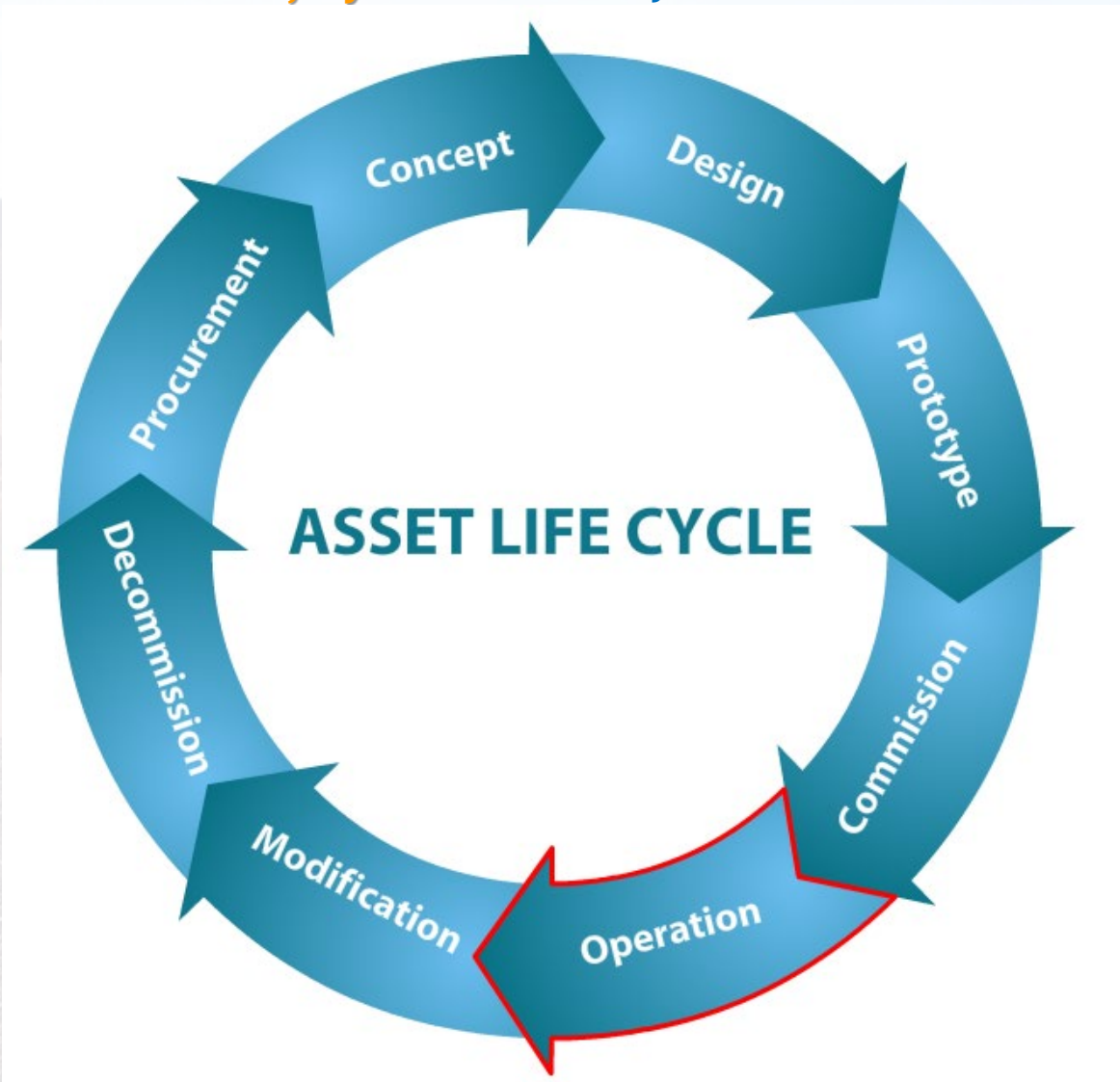
EMESRT strategy



OMAT Applications

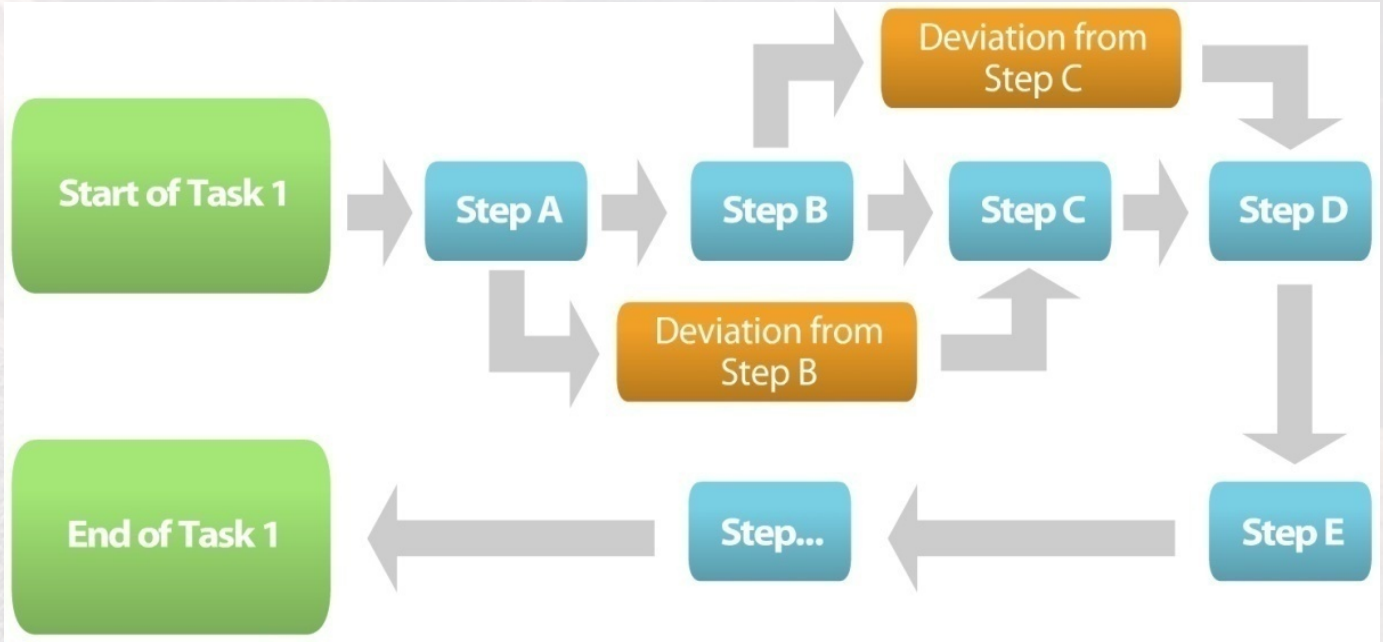
1. For a mine site, to assess their equipment. This may be to help:
   - Make decisions about purchasing/modification.
   - Investigate incidents.
   - Audit the modification/retrofits.
   - Give feedback to manufacturers/EMERST.

2. For OEMs, to help design and build safer equipment through:
   - Leading a priority risk identification and control process and
   - facilitating the engagement with EMERST and mining companies through using a common tool and language.


ASSET LIFE CYCLE
Concept
Design
Prototype
Commission
Operation
Modification
Decommission
Procurement

Overview of OMAT

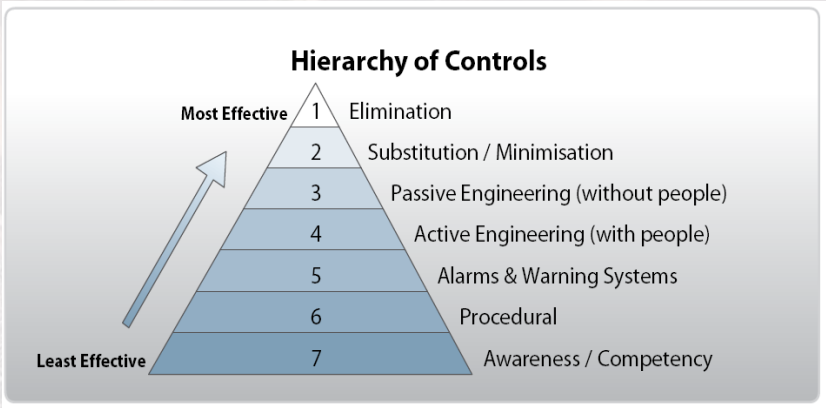
Task Description	Task Type	Task Frequency	Consequence Input – Key Hazards 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Priority Score
TASK 1	Oper	6	3	5	2				5									1380
TASK 2	Oper	6	3	5	2				5									1380
TASK 3	Oper	6	2	2		1			5						5			1266
TASK 4	Oper	5	3	5	1		2		5									1155



Overview of OMAT

- Critical Task Identification
- Task Flow Chart
- **Risk Identification**
- **Solution Options**
- Feedback & Action Plan
- Equipment Risk Register

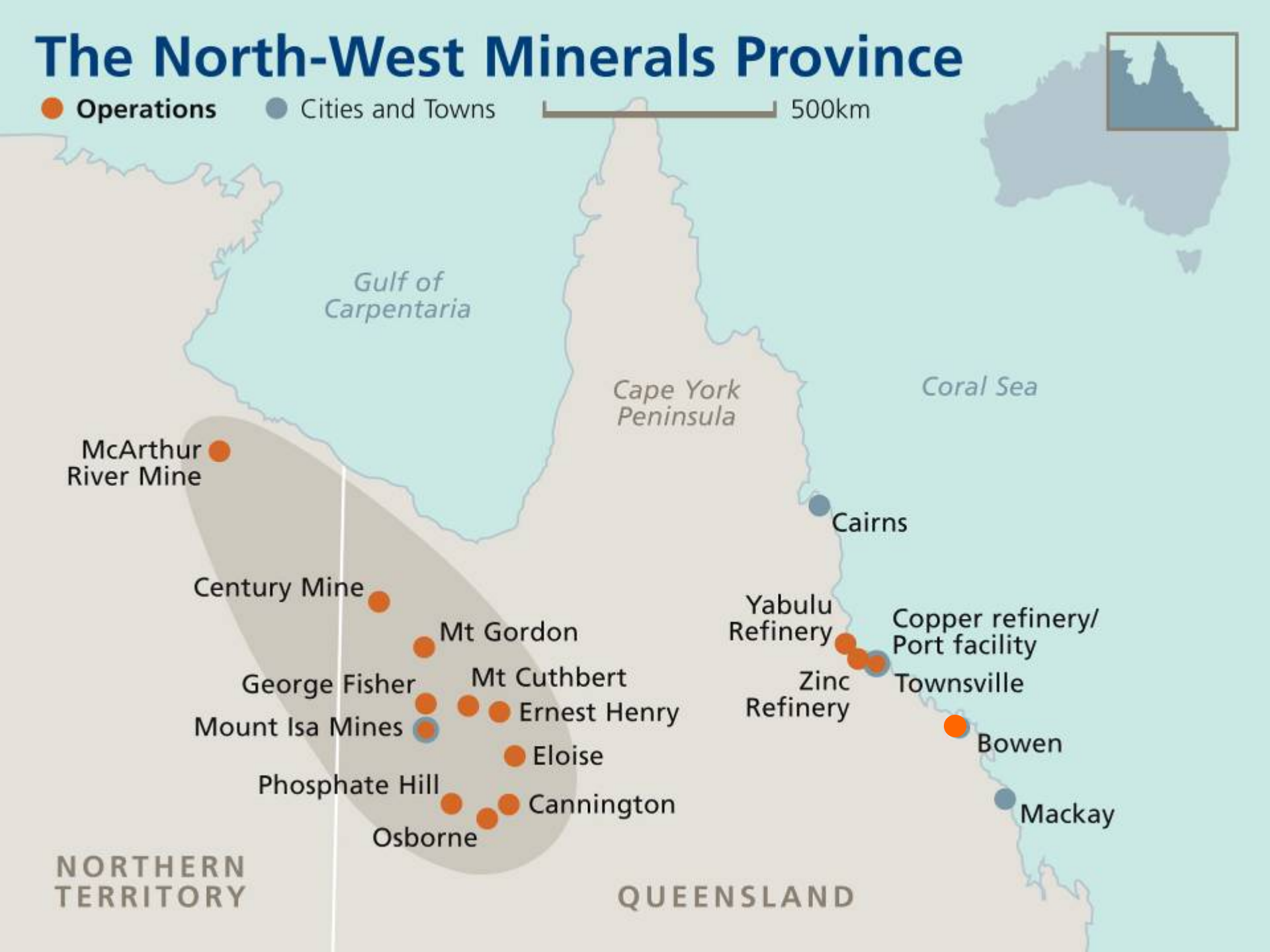
Likelihood	Consequence				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
5 Certain	*High*	*High*	*Extreme*	*Extreme*	*Extreme*
4 Likely	*Medium*	*High*	*High*	*Extreme*	*Extreme*
3 Possible	*Low*	*Medium*	*High*	*Extreme*	*Extreme*
2 Unlikely	*Low*	*Low*	*Medium*	*High*	*Extreme*
1 Rare	*Low*	*Low*	*Medium*	*Medium*	*High*



Overview of OMAT

EMESRT

- Critical Task Identification
- Task Flow Chart
- Risk Identification
- Solution Options
- Feedback & Action Plan
- Equipment Risk Register


The North-West Minerals Province
Operations
Cities and Towns
500km
Gulf of Carpentaria
Cape York Peninsula
Coral Sea
McArthur River Mine
Cairns
Century Mine
Mt Gordon
George Fisher
Mt Cuthbert
Ernest Henry
Mount Isa Mines
Eloise
Phosphate Hill
Cannington
Osborne
Yabulu Refinery
Copper refinery/ Port facility
Zinc Refinery
Townsville
Bowen
Mackay
NORTHERN TERRITORY
QUEENSLAND

Xstrata North Queensland

- 4500 employees (including contactors)
- Mount Isa
  - **Two UG Copper Mines – Enterprise and X41**
  - **1,800 metres deep**
  - **Concentrator and smelter**
  - **George Fisher underground zinc-lead mine, Black Star Open Cut mine and Handlebar Hill Open Cut mine (care and maintenance)**
  - **Concentrator and smelter**
- Ernest Henry Mining
  - **Open cut**
  - **Concentrator**
- Townsville Copper Refinery and Port Operations
  - **Cathode refinery and port operations**
  - **Technology**

Bowen Coke

- **Coking coal to the lead smelter**

Context

- Assist in the development of Design Philosophies (manual tasks, access/egress)
- Trial the tool as a potential resource for direct communication with OEMs through EMESRT
- Provide feedback and assist in OMAT development

Scope

- Manual task and role specific focus
- Identify tasks that may be contributing to the development of Cumulative Trauma Disorders in maintenance personnel (Diesel Fitters)
- Determine their relationship to LHD units (Mucking Units)
- TORO T11 maintenance activities observed

OMAT -TORO T11

OMAT Overview

- Conducted on site in operating workshop (Underground Copper).
- Team members:
  - Supervisor, Crew members, Occupational Therapist and Graduate Occupational Therapist
- 2 x OMAT assessments conducted:
  - OMAT 1: Weekly scheduled tasks
  - OMAT 2: Engine re-fit tasks
  - Duration: 1 shift/OMAT

OMAT
Stage 1: Critical Task Identification

- Weekly checks (OMAT 1):
  - Proactive maintenance task
  - Over 100 tasks identified for initial assessment

- Engine changeover (OMAT 2):
  - Proactive maintenance task
  - 27 task groups identified for initial assessment

OMAT-
Critical Task Identification

- Identified 10 Tasks as critical:
  1. Pin insertion at boom arm
  2. Engine fuel Line checks
  3. Induction hose checks and adjustment.
  4. Fan and alternator belt checks
  5. Coolant level checks, radiator and hydraulic drive motor hoses
  6. Battery checks
  7. Drive line checks (bolts secured)
  8. Wiring checks
  9. Engine mounting bolt removal and installation
  10. Air filter checks and changes

- Access/Egress

Stage 2: Flow Chart

- Changed steps/boxes as the task performance characteristics changed:
  - Exertion, posture (consistently identified)
  - Component of the task (i.e. lift tool, access working area, establish working posture, tool use, tool removal, etc)

- Detailed step by step descriptions of the task:
  - Written

- Identify which components of the task may be a concern (cumulative and acute injury risks)

Flow Chart

Task 1 – Pin Insertion

	<Function>	<Function>	<Function>	<Function>	<Function>	<Function>	<Function>
Left Side Unit	1.1a Assemble pin on L front wheel arch.	1.2a Ascend L vehicle front wheel arch from ground, and stabilise. 1.2b Access L vehicle front wheel arch from top of unit and stabilise	1.3a Grasp pin with L upper limb. Static exertion involving power grasp, with 45 degrees forearm supination.	1.4a Brace trunk and upper body.	1.5a Transfer pin across midline to insertion point (L elbow flexion with compensatory shoulder elevation > L shoulder adduction, internal rotation).	1.6a Force pin securely into hole, utilising R upper limb and hip.	1.7a Descend vehicle to ground via wheel arch. Unilateral handrail available.
Right Side Unit	1.1b Assemble pin on R front wheel arch.	1.2c Ascend R vehicle front wheel arch from ground, and stabilise. 1.2d Access R vehicle front wheel arch from top of unit and stabilise	1.3b Grasp pin with R upper limb. Static exertion involving power grasp, with 45 degrees forearm supination.	1.4b Brace trunk and upper body.	1.5b Transfer pin across midline to insertion point (R elbow flexion with compensatory shoulder elevation > R shoulder adduction, internal rotation).	1.6b Force pin securely into hole, utilising L upper limb and hip.	1.7b Descend vehicle to ground via wheel arch. Bilateral handrails available.

Stage 3: Risk Identification

- Awkward Postures:
  - Drive line checks
  - Wiring and fuel line checks
  - Engine mounting bolts
  - Medium-long duration exposure to postures

- Exertions:
  - Pin insertion and removal at boom
  - Loosening hose connections to engine
  - Loosening bolts (engine mounting bolts)
  - Short duration max exertions

- Tool use (manual and energised) :
  - Removal of engine mounting bolts and fixtures (posture and exertion)
  - Manual tool use (posture and exertion)

Access and egress (unit surfaces and bay access)

Awkward Postures

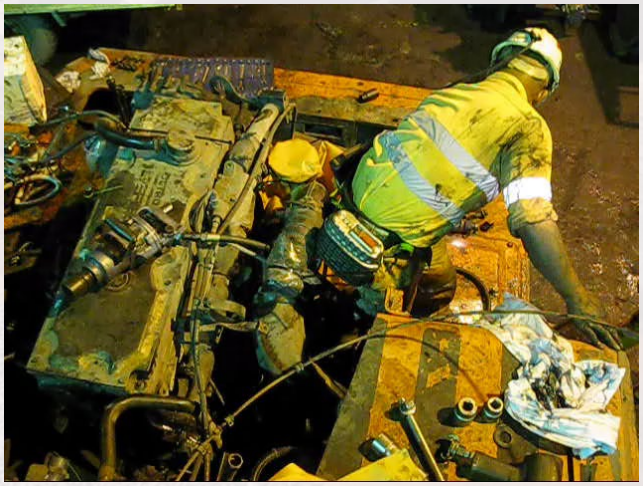
Awkward Postures

Awkward Postures

Exertion & Awkward Postures (Tool use)

Mounting bolts:
impact gun

Boom bracing:
pin insertion



OMAT (TORO T11) – Access/Egress

- Rear
- First Step
  - Distance
  - Identification and foot placement (poor viewing).
- Transfers on unit
  - Trip Hazards and no clear path (R rear).

OMAT (TORO T11) – Access/Egress

- Front
  - R grab rails/grip point absent.
  - First Step distance large.
- Egress
  - Awkward first step down.
  - No Grab rails/hand supports
  - Slips/trips/falls
- Cabin
  - First Step Distance
  - Awkward/reduced space.
  - Operating Position

Exertion

Manual Tool use: Engine mounting bolts

Stage 4: Solution Options

- Pin Insertion at Boom:
  - Cabin controlled boom mechanism.
  - Sliding brace permanently attached to boom arm.

- Access/Egress
  - Non -slip surfaces around steps.
  - Bilateral grab rails at all access egress points.
  - Additional step/s
  - Step colour differentiation.
  - Lighting on foot pegs/steps.
  - Reflective strips on steps.

Stage 5: Feedback and Action Plan

- Communicate Outcomes to Workforce.
  - Planning.
- Include outcomes and learning into Design Philosophy development.
  - Completed.
- Presentation of results to EMESRT:
  - Completed.
- Communicate concern areas to OEM through EMESRT.
  - Planning.

OMAT Feedback

- Provides rich, contextual and documented evidence base.
- Facilitates a complex and time consuming process.
- Amalgamates multiple processes into 1 x assessment.
- Time taken and observation in real time environment.

EMESRT

Questions?

ANGLO AMERICAN BARRICK bhpbilliton resourcing the future NEWCREST MINING LIMITED NEWMONT VALE xstrata MISHC