BMA Broadmeadow - Underground Proximity Detection Trials on Mobile Equipment

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Discussion Points

- PDS Project Objectives;
- Priority Interactions;
- Broadmeadow PDS Installations;
- Underground Shuttle Car Trials;
- Where to next ? – LHDs and Personnel Transporters.

Preamble

Prior to drafting this presentation, I sat down with David Cook, ERZ Controller of the first Production crew of the trials and David Zanette, Project Implementation, as a lesson learnt session. I appreciate their time and reflections during the underground trial and Production integration. Both David's contributed significantly to the Projects success.

PDS Project Objectives

MDG 2007

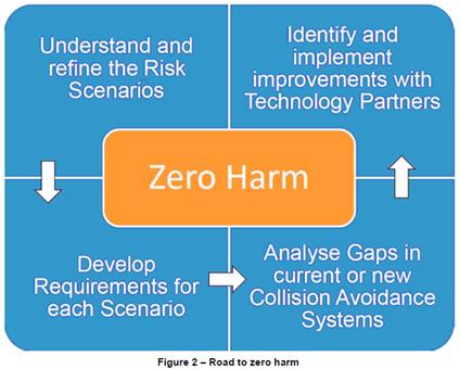

Figure 2 – Road to zero harm

Understand and refine the high risk scenarios:

- Determine mobile equipment with highest interaction risk;
- Assess current safeguards levels and identify gaps;
- Identify mobile equipment to be fitted with Level 7-9 safeguards.

Develop requirements for each scenario:

- Generate technology profiles for Collision Avoidance Systems;
- Develop User requirements, technology specifications, interface specifications for Proximity Detection system.

Analyse gaps in current or new Collision Avoidance Systems:

- Select a Proximity Detection vendor that best meets technology profiles;
- Develop commissioning sheets and a standard set of scenario tests for proximity detection trials (300+ different scenarios);
- Trial selected vendor(s) on selected mobile equipment in a surface trial at Broadmeadow;
- Progress to underground trials;
- **Decision point for Production rollout**

Identify and implement improvements with Technology partners:

*Image Sourced from "MDG 2007 Guideline for the selection and implementation of collision management systems for mining" (Feb 2014)

PDS Workshop Results - Priority Interactions

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Priority Interactions:

- The potential of Shuttle Cars and Ram cars, interacting with personnel (pedestrians) is the highest contributor to interaction risk in the combined “BMA” & “Industry” data sets;
- The potential of UG Loaders, interacting with UG Personal Transporters is the 2nd highest contributor to interaction risk in the combined “BMA” & “Industry” data sets;
- The potential of UG Loaders, interacting with personnel (pedestrians) is the 3rd highest contributor to interaction risk in the combined “BMA” & “Industry” data sets.
- Note: Almost all interactions reviewed were estimated to be <10km/hr.

Table 73: Priority Interactors – All incidents (BMA & Industry)

Local Object		Incidents	RRR	Person	Equip-ment	Infra-structure	Uncon-trolled	Unstable Ground
Interactor	Object Code			PUE1	PUE2	PUE3	PUE4	PUE5
				45.7%	**36.0%**	**3.5%**	**9.2%**	**5.5%**
		65	**343.5**	**157.0**	**123.7**	**12.1**	**31.7**	**19.0**
Shuttle Car	UME_PRI	8	104.3	69.0	30.0	-	5.3	-
UG Loader (with bucket)	UME_MUE	17	79.0	18.0	38.9	9.1	13.0	-
UG Loader (with implement other)	UME_MUE	11	38.2	12.0	25.0	-	1.2	-
UG Personnel Transport	UME_SDV	8	36.9	9.0	22.9	3.0	2.0	-
UG Loader (with implement man)	UME_MUE	4	25.0	3.0	3.0	-	-	19.0
Ram car	UME_PRI	3	21.0	21.0	-	-	-	-
Retriever Dozer	UME_SEC	2	18.0	18.0	-	-	-	-
Bolter Miner	UCE_PCE	7	13.6	4.0	-	-	9.6	-
UG Grader	UME_SEC	1	3.0	-	3.0	-	-	-
Chock Carrier	UME_SEC	1	3.0	3.0	-	-	-	-
UG Loader (no implement)	UME_MUE	1	0.9	-	0.9	-	-	-
Trailer Attachment	USP_TSP	2	0.6	-	-	-	0.6	-

Broadmeadow PDS Installations

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Warning Only mode (Level 7)

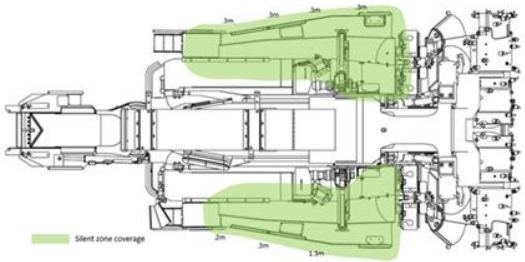
- Electric Personnel Transporter
- Diesel UG Personnel Transporter
- Moxy Truck
- Underground Loader

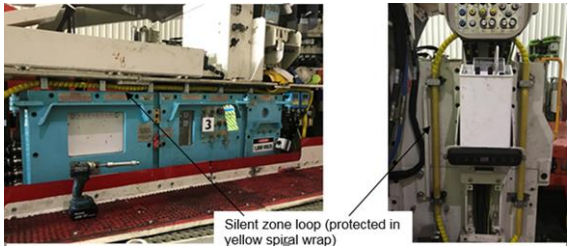
Full Auto Stop Mode (Level 9)

- 6 x Shuttle cars
- Underground Loader – Successful Prototype complete, further testing 2023

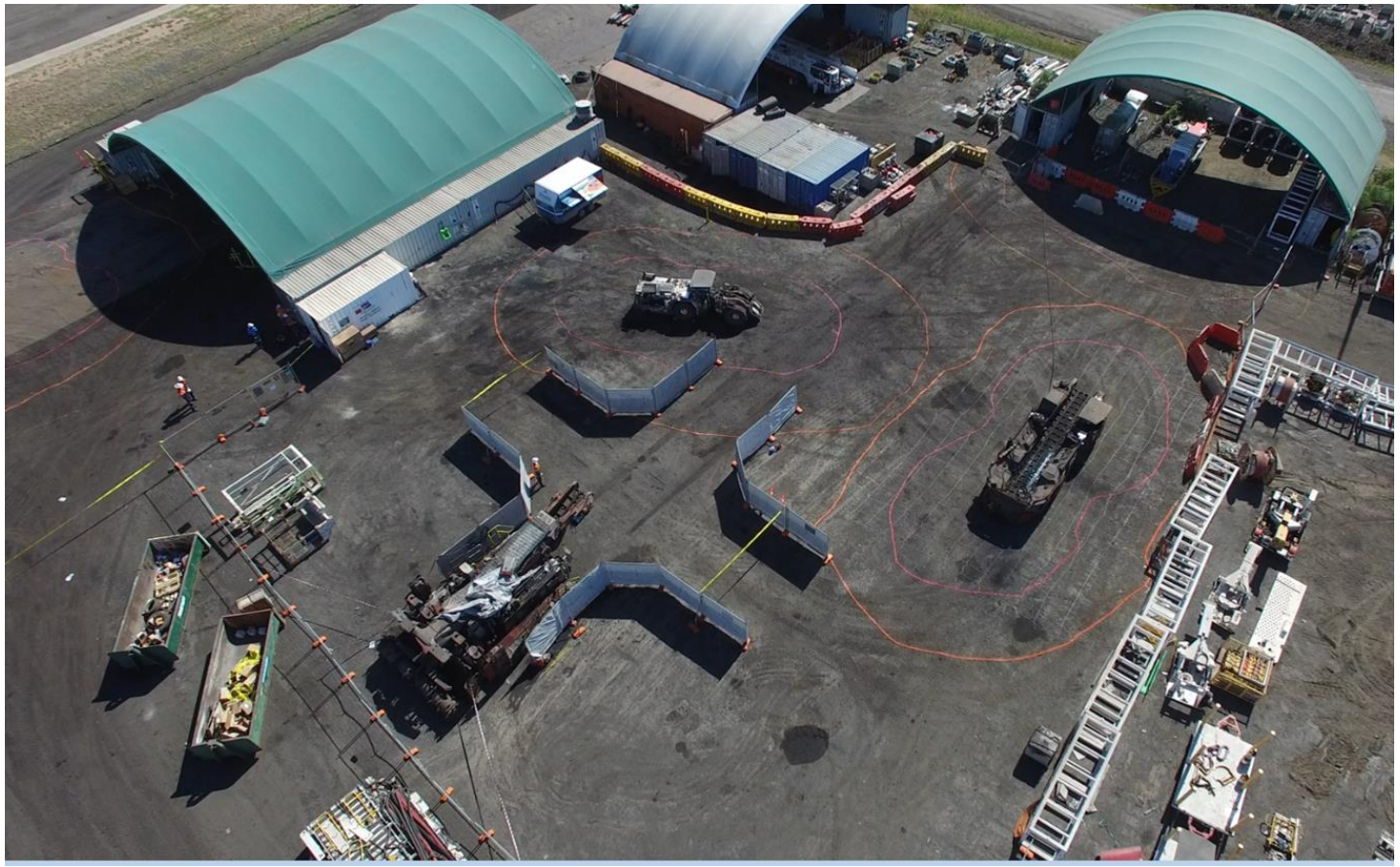
Silent Zone

- 4 x Bolter Miners
- 3 x Boot end





PDS Test Area



Underground Shuttle Car PDS Trials

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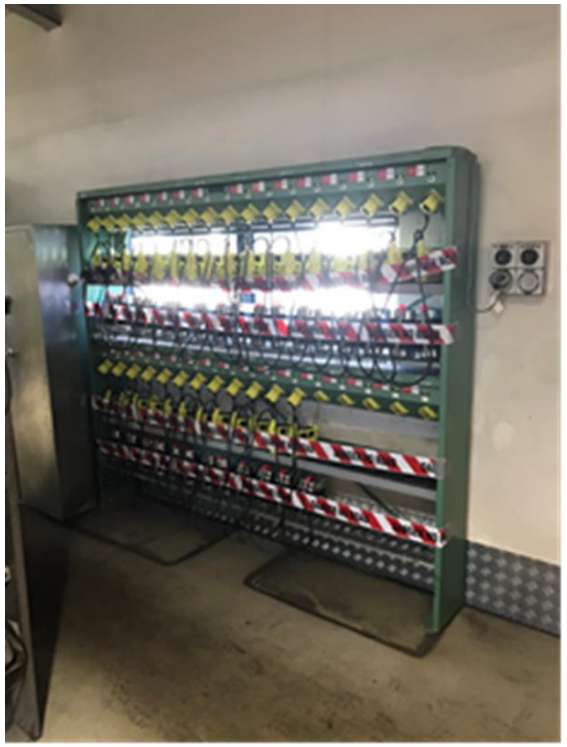
PDS Trials Set up

- 30 Caplamps were fitted out with PDS PADs in a dedicated cap lamp rack in the Muster Area;
- A Caplamp PDS Checkout Station was installed in the Muster Area;



ALWAYS TREAT THE PDS AS IF IT IS OFF. NORMAL NO-GO ZONES STILL TAKE PRECEDENCE

Underground Shuttle Car PDS Trials

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"Auto Slow/Stop" Phase

- Trials - progressed to Full Auto/Slow Stop;
- Over 2 years in full operation;
- Positive feedback received from all crews. Adopted by crews as normal operations;
- Ceased poor behaviour's developing or continuing with in crews;
- Positive behavioural change with operators tending to move further back from an operating shuttle car because of unwanted interaction with a trip or slow warning.

Key Points:

- BMA Leadership team – Strong support for initial trial;
- Development Crews – Early engagement with crews resulted in a positive outcome;
- Commitment from Operations to "Fix it" resilience, instead of reverting to bypassing the PDS and continuing operations.
- Safety and Health Management System Development

Issues & Improvements

Surface Testing:

- Initially we were seeing variation in cap lamp detection zone accuracy – re-calibrated all cap lamps and issue is resolved;

Underground Testing:

- WIFI Card Data – resolved;
- Web Based reporting system needs improvements;
- Interference from certain hand held electronics devices and large steel structures;
- Installed Silent zones around the Boot End hydraulic controls to reduce false positives.

Ongoing:

- PDS Caplamps, Support and Service (Section 81,Ex Compliance);
- Loss of site knowledge base - Trades;
- Additional Capital Investment – 220 additional caplamps.

Shuttle Car OEM PDS Interface

Komatsu Interface

Inputs

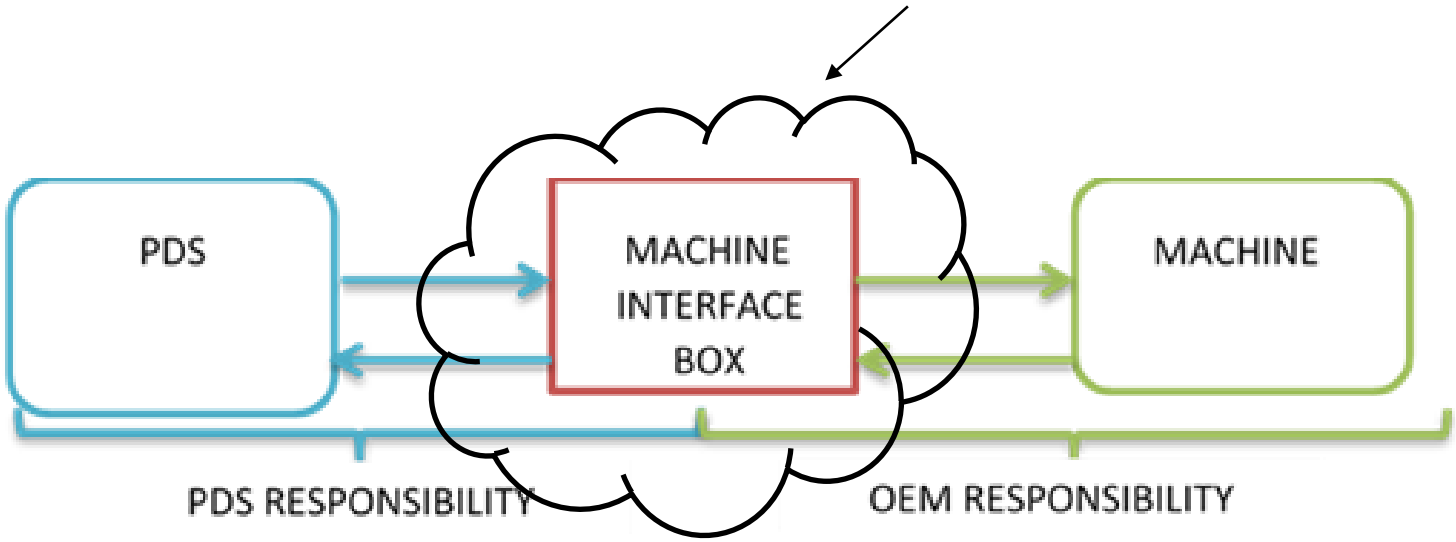
- Warning Zone Signal – slow machine to % speed
- Stop Zone Signal – Stop Pump
- 2nd Stop
- Fields on/off

Diesel Machines

- 3rd party Interface?
- ISO 21815

Outputs

- Park Brake input



PDS Project – Next Steps

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LHDs - 2023

- LHD Auto slow/stop prototype
- ISO 21815 - Collision warning and avoidance
- Further testing underground attachments in production
- Vehicle to Vehicle

Other UG Vehicles

- Chock Carrier, UG Dozer, Graders

Dynamic Zone Sizing

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