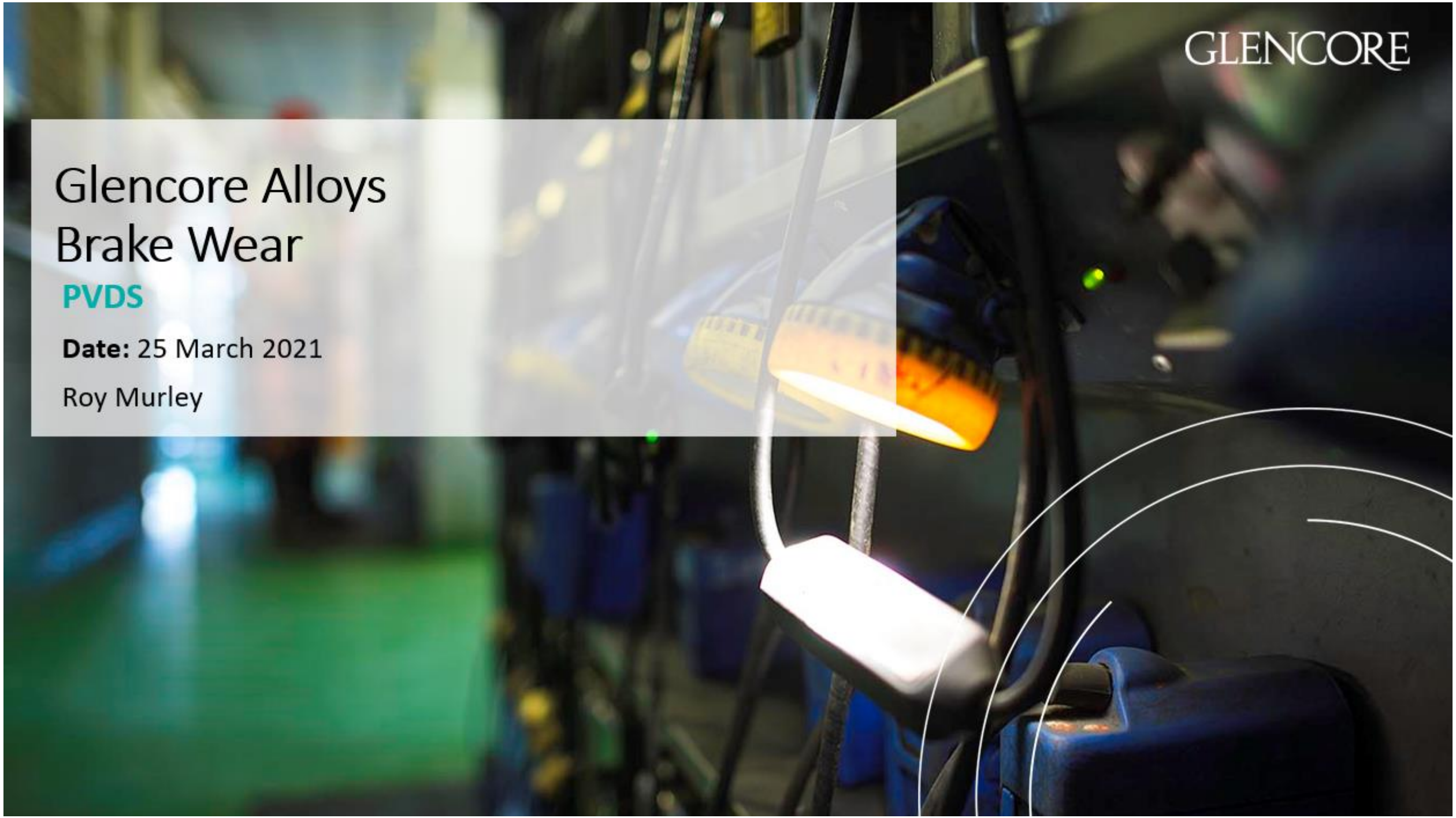


Glencore Alloys Brake Wear

PVDS

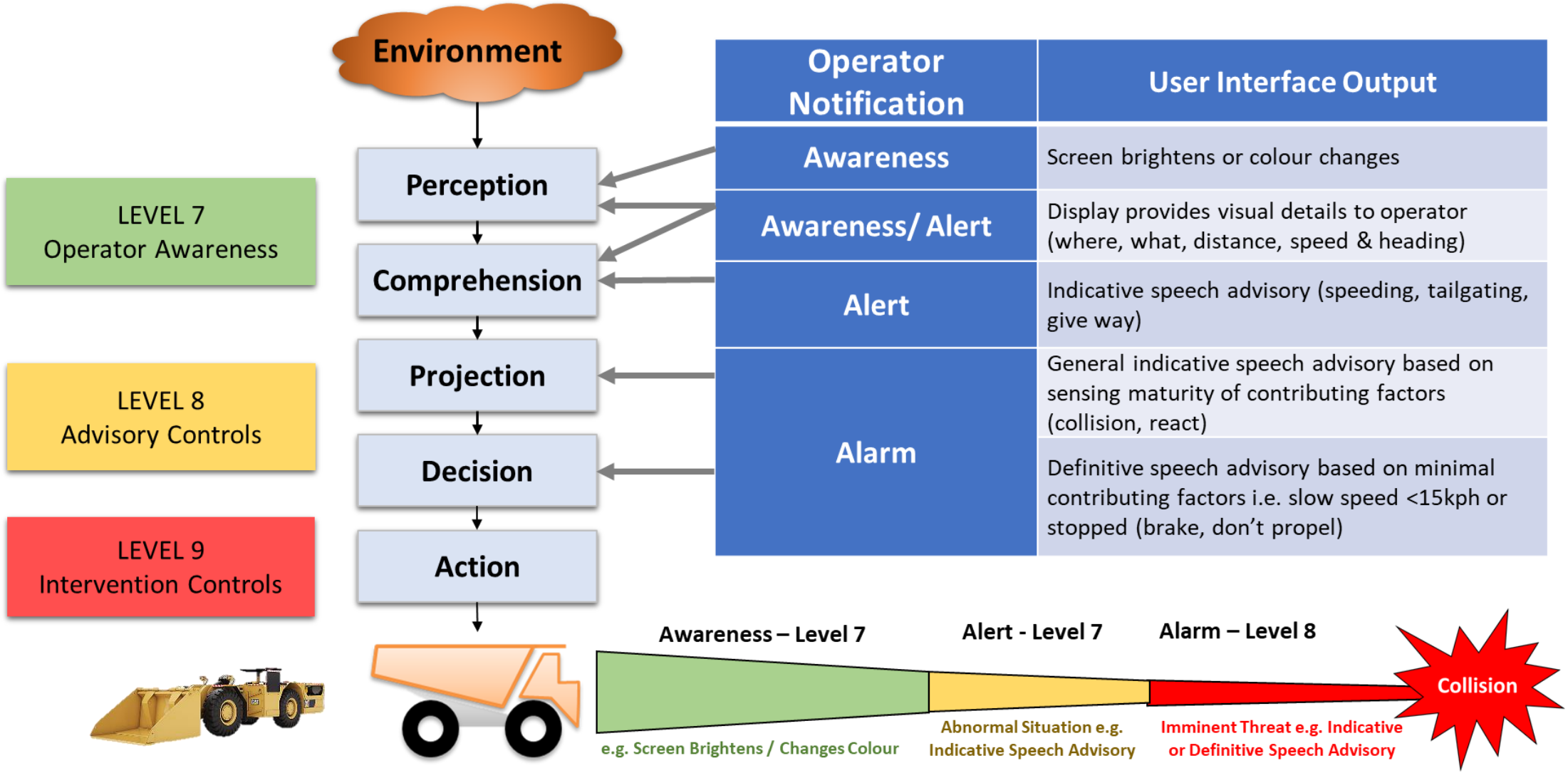
Date: 25 March 2021

Roy Murley

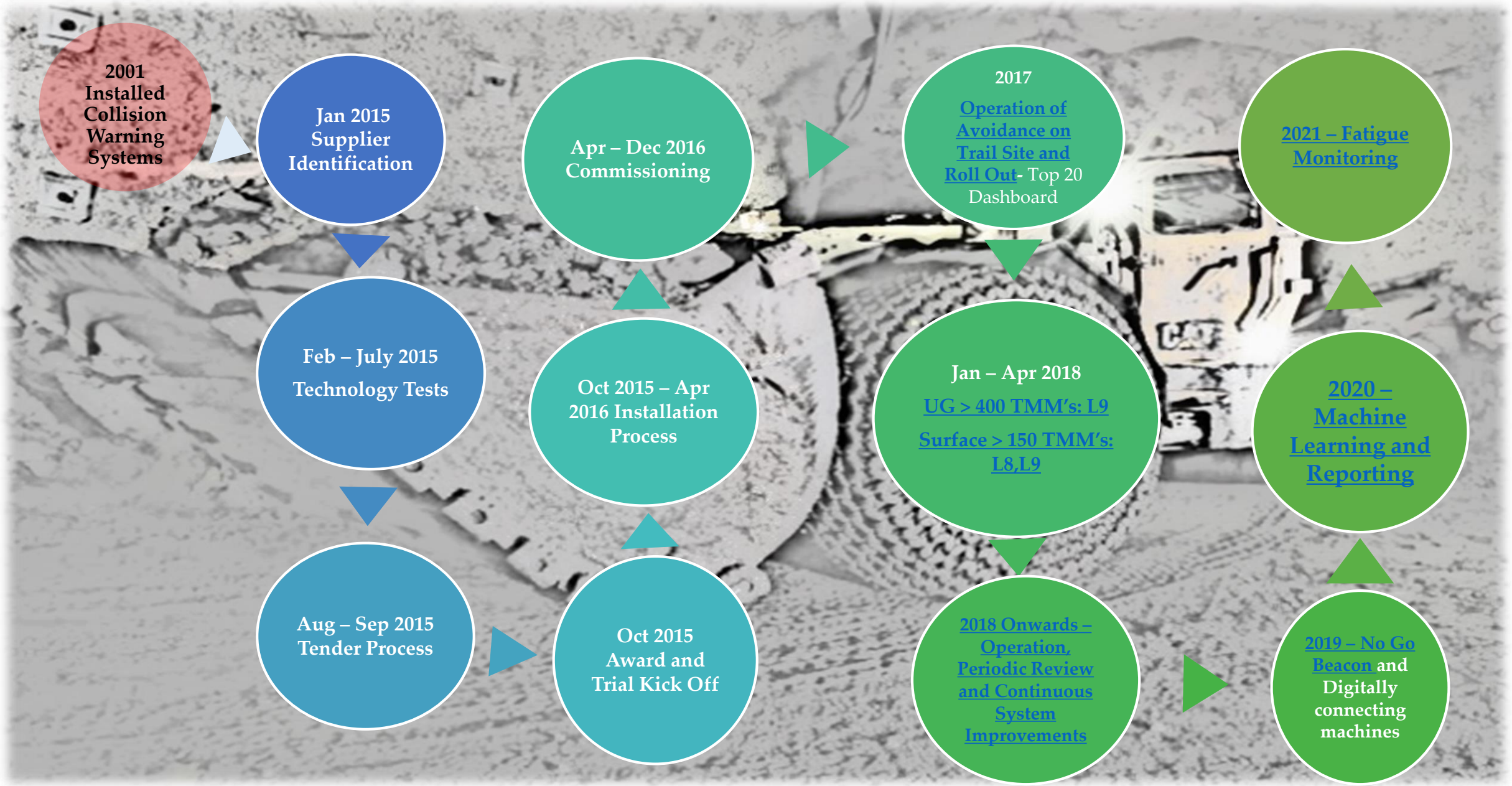
Combining Models for a deeper understanding

Example from a Glencore Surface and Underground Mining Vehicle Interaction Technology Implementation Project

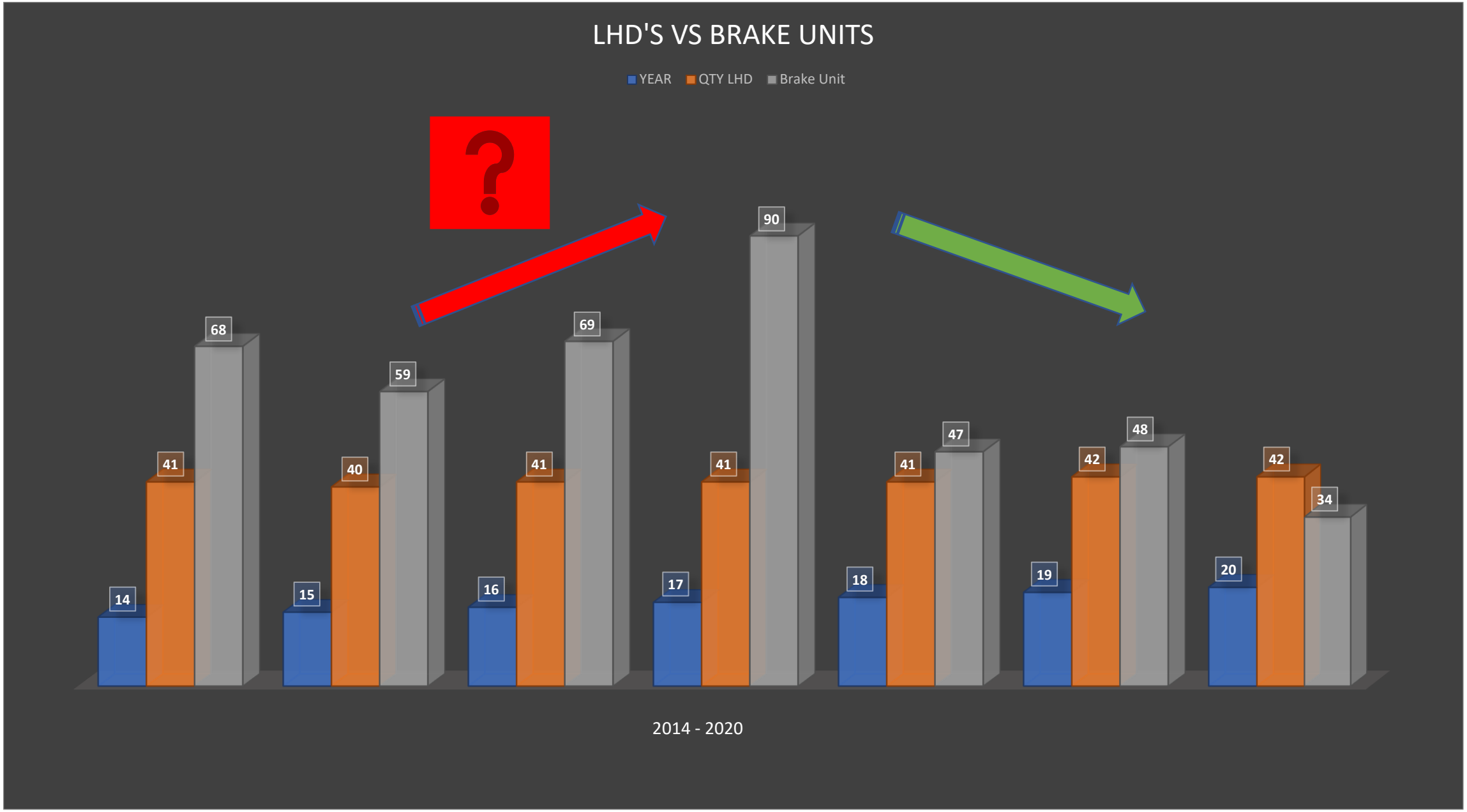
- Human Factor Interaction Model
- EMESRT Nine Layer Model of Control Effectiveness
- Mica Endsley Model of Situational Awareness



Journey to Collision Avoidance – Level 9



Brake Unit Analysis



PVDS - Interactions

- **Interaction or Event Management:**
  - **Daily reporting on events**
  - *Proximity events*
  - *Warning events*
  - *Critical proximity events*

  Continuous improvement and employee management by Supervisor's

  Top "20" Infringement
  - **Monthly review and reward for sections with:**
  - *Best improvement*
  - *Lowest overall events*

- **Target:**
  - *Reduce unwanted interactions completely*
  - *Change in employee behaviour*
  - *Prevent complacency – Operator and Pedestrian*

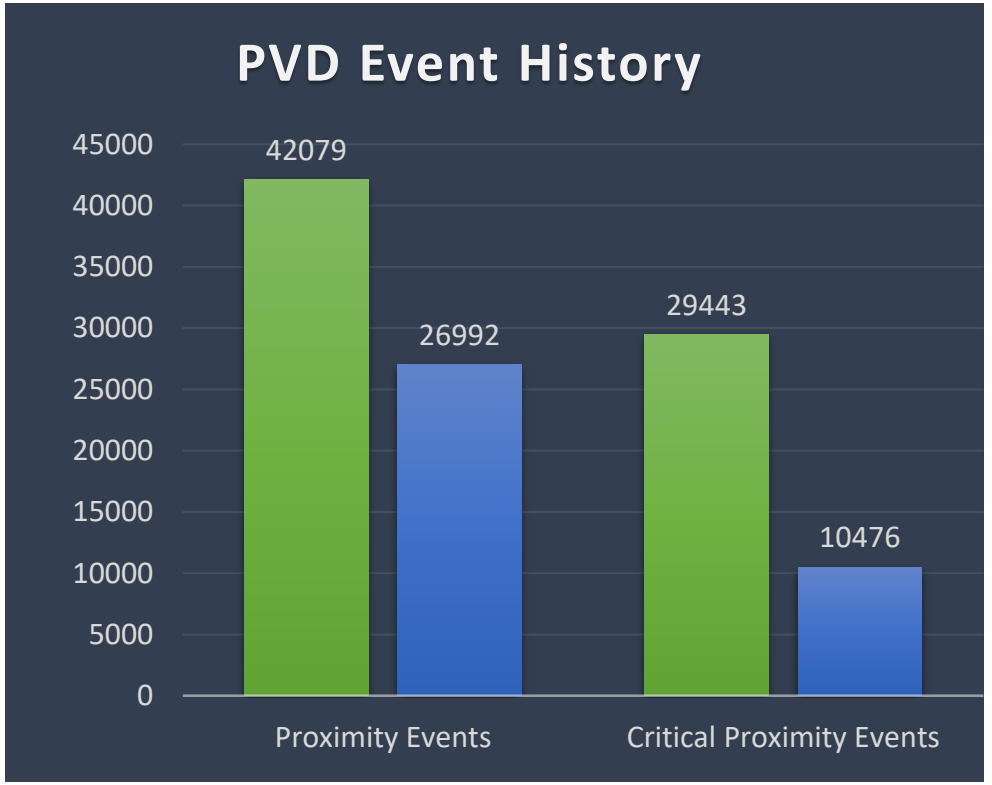
- **Current results:**
  - *Reduction in events by 46%*
  - *Clear change in employee behaviour*
  - *Employees instinctively avoid TMMs*
  - *Traffic management rules are enforced*
  - *Safe behaviour becomes second nature*
  - *Quality of Repairs*

How?

Improvement since Jan 2017 :

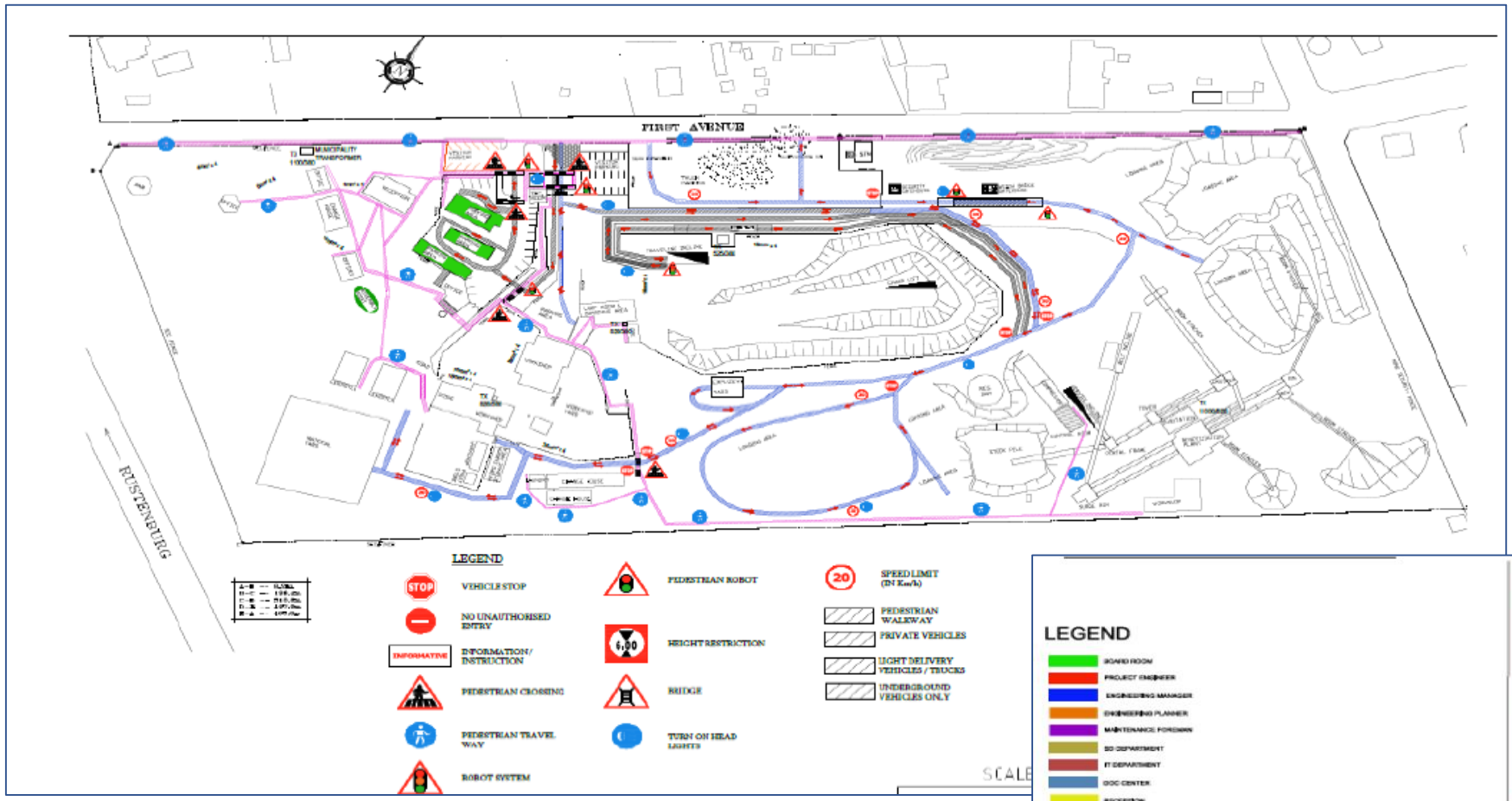
- *Proximity events – reduced by 46%*
- *Critical proximity events (stops) – reduced by 64%*

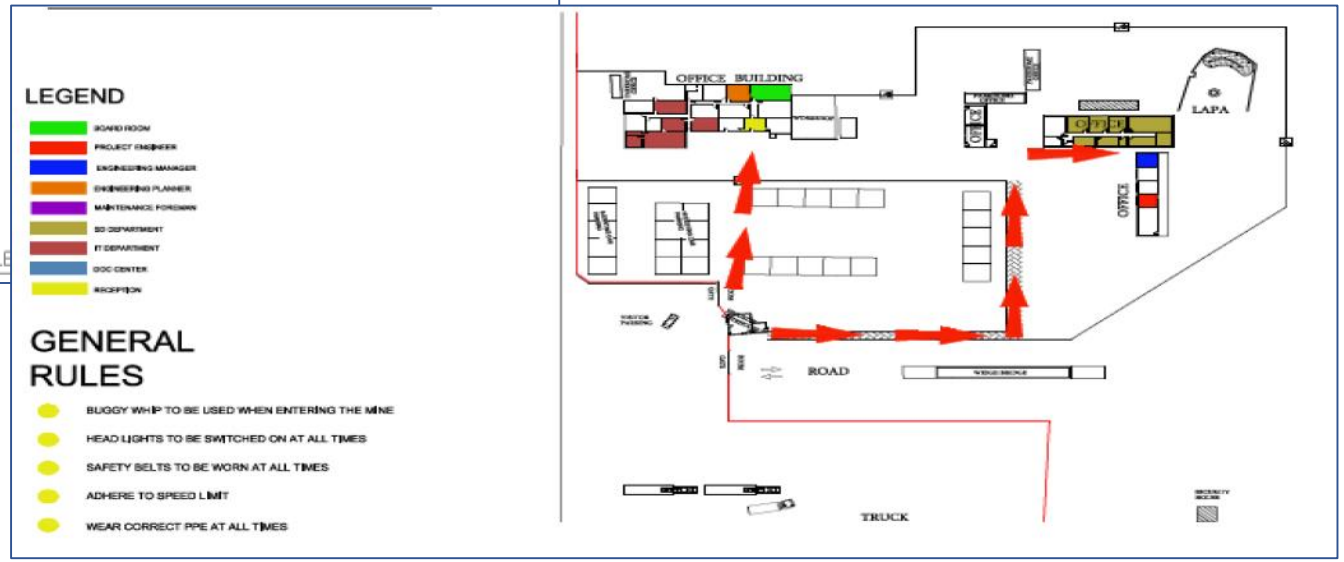
(Note – proximity events also take into consideration when TMM is already stationary and does not reflect physical emergency stops)



Traffic Management - Surface

- Flow and
- Analysis





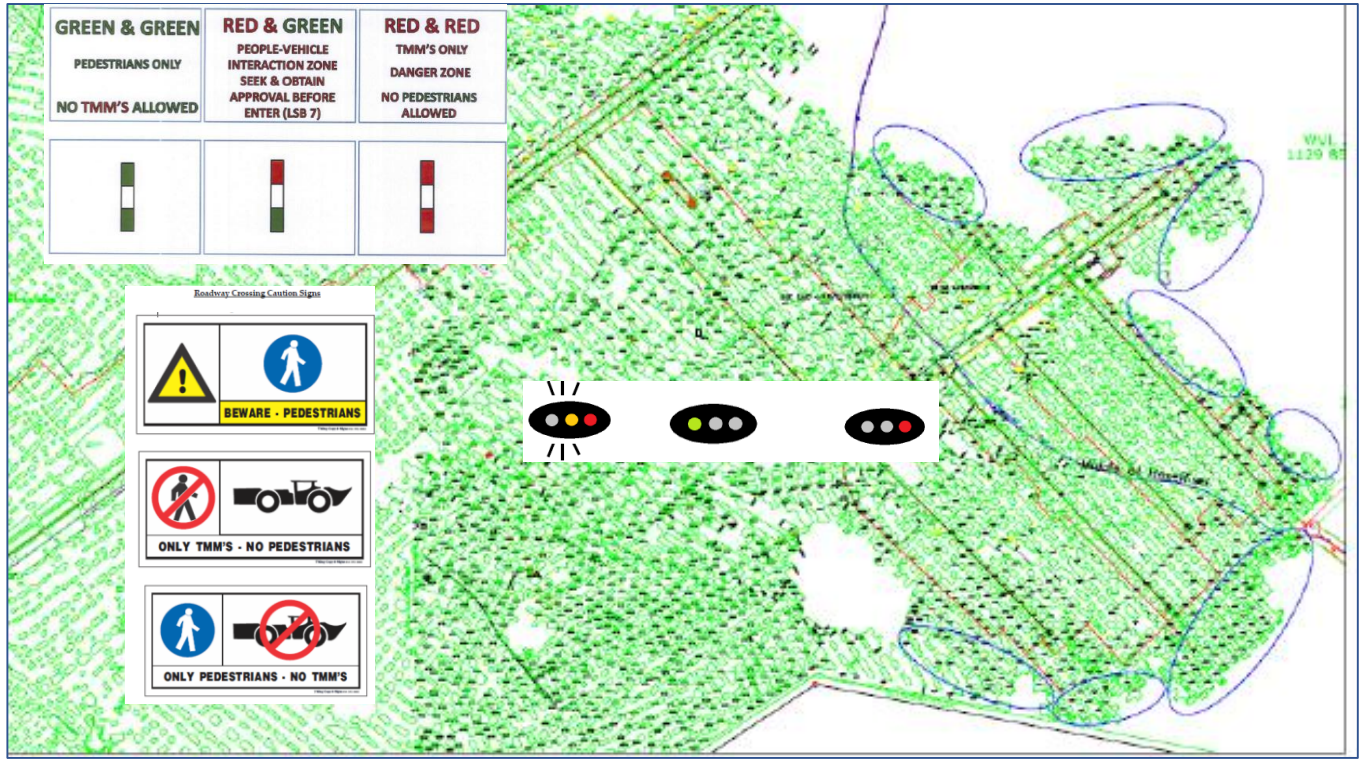
Key Notes:

- Proper Understandable signage
- Fit for Purpose
- ALL AREAS
- Training Training Training - Repeat

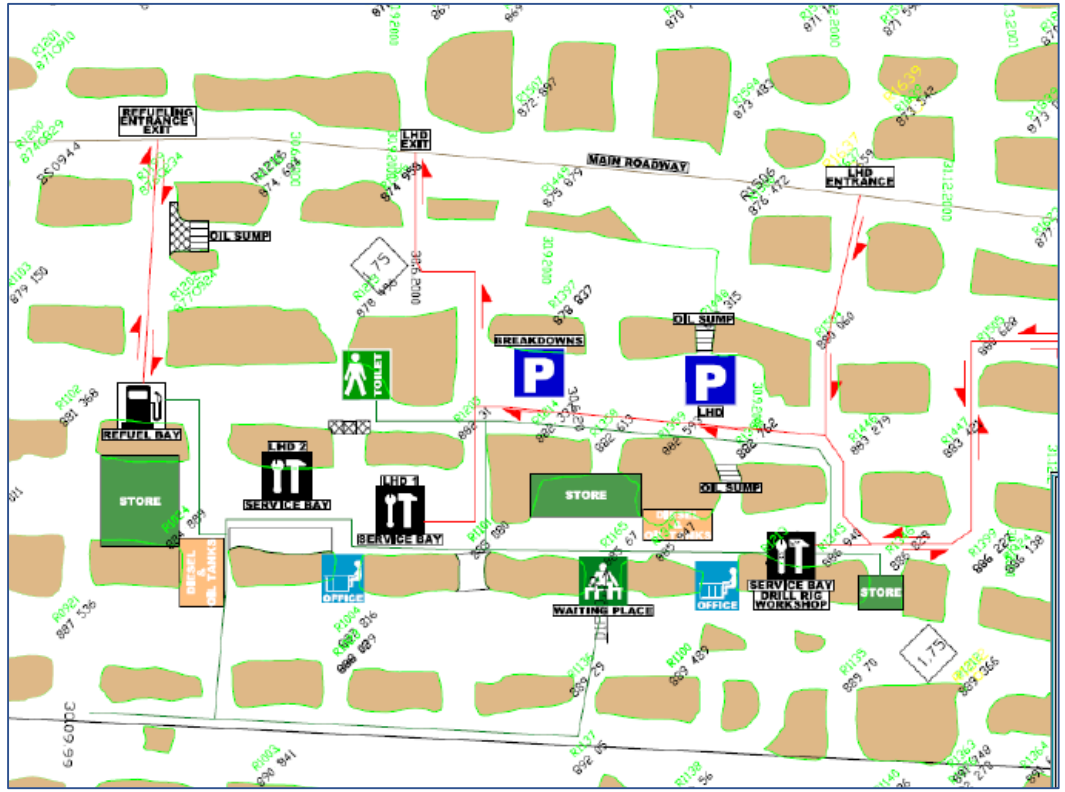
Traffic Management - Underground

- Flow and
- Analysis

Working Areas including Tipping points



Workshop's – Crawl Mode



Key Notes:

- Proper Understandable signage
- Fit for Purpose
- ALL AREAS
- Training Training Training - Repeat

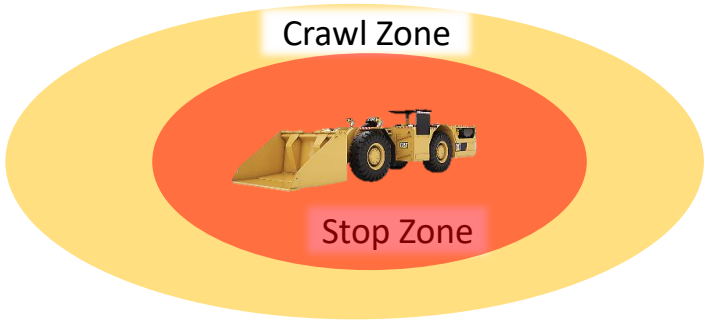
Dynamic Zoning

Dynamic zoning on the PAS1000 adjusts the critical and warning zone sizes based on the speed of the vehicle. This has the effect of reducing the footprint of the system at low speeds in order to improve productivity.

Zone sizes

The zone sizes vs speed used by the system are as in the following table. These can be adjusted based on actual characteristics of the vehicles in the operation.

Speed	Stop distance (m)	Crawl distance (m)
Stationary	3	5
< 3km/h	4.6	8.1
< 5km/h	6.2	11.7
< 8km/h	8.6	15.1
< 11km/h	11.0	19.5
< 15km/h	14.5	25.0
< 20km/h	19.0	33.5
< 25km/h	23.0	40.5
> 25km/h	27.0	47.5



L9 Intervention Zone Distances

10 km/hr

From The Distance Specification Table

From The Distance Specification Table with all Lags and Gap zeroed

PDS Action	PDS Delay	Operator Delay	Interface Delay	Controller Delay	Transition Delay	Total Delay		Speed	Speed	PDS Delay	Operator Delay	Interface Delay	Controller Delay	Transition Delay	ISO 3450 Stopping Distance	Gap	Total Distance
	s	s	s	s	s	s		km/hr	m/s	m	m	m	m	m	m	m	m
Alarm 7	1	2	0	0	4.0	7.0		10	2.8	3	6	0	0	11	2	2	23
Stop 8	1	1	0	0	2.0	4.0		10	2.8	3	3	0	0	6	2	2	15
Stop 9	1	0	0.5	0.5		2.0		10	2.8	3	0	1	1	0	2	2	9
											6						

Transition Delay to spread the zones

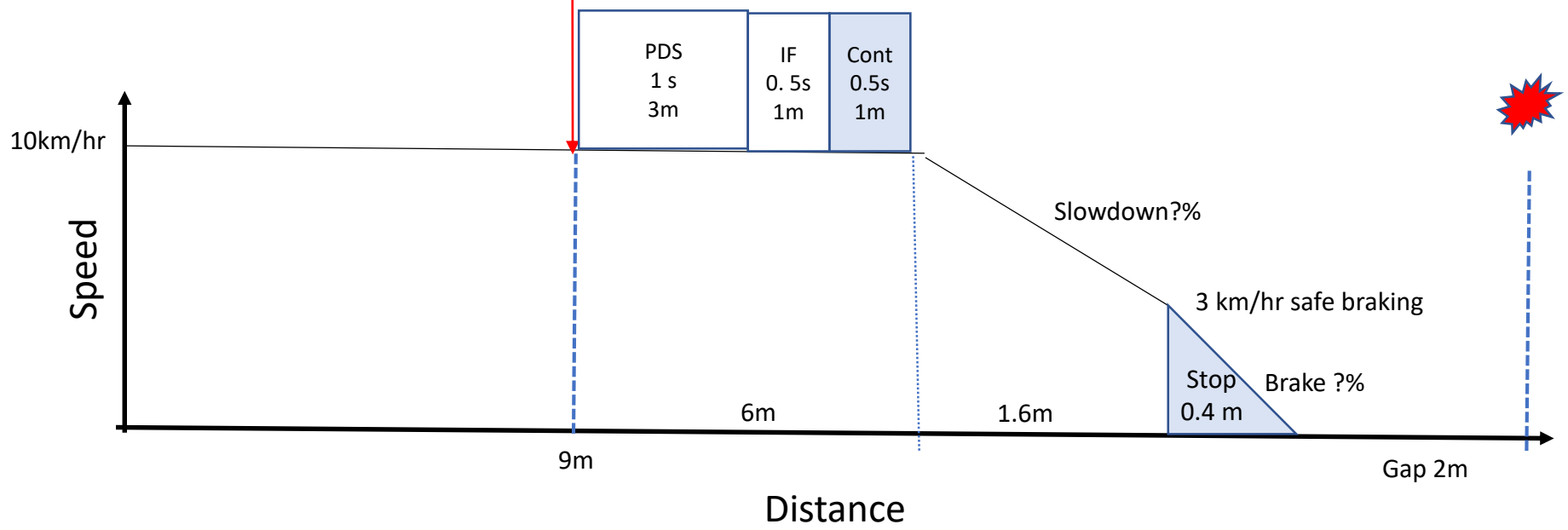
= Previous Total Delay

L9 Critical

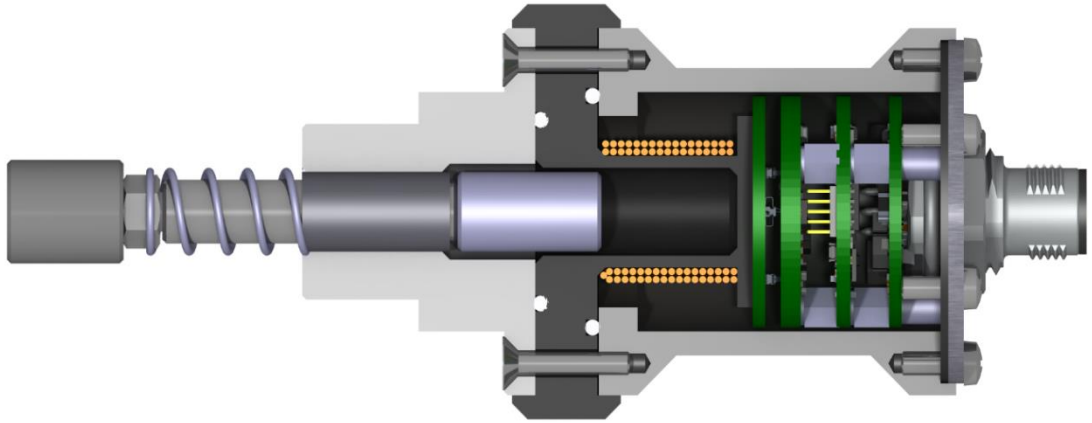
L9 Slowdown & Stop

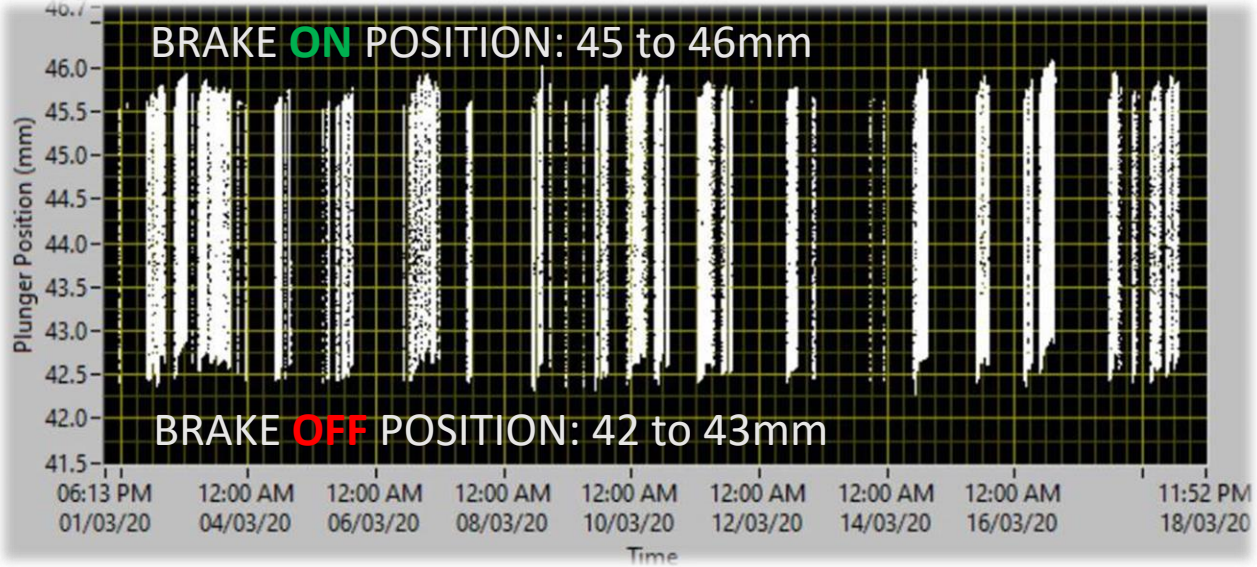
Total L9 Delay Distance

Total Distance same as Distance Specification Table



Technology “Brake Wear Solution” – TMM’s





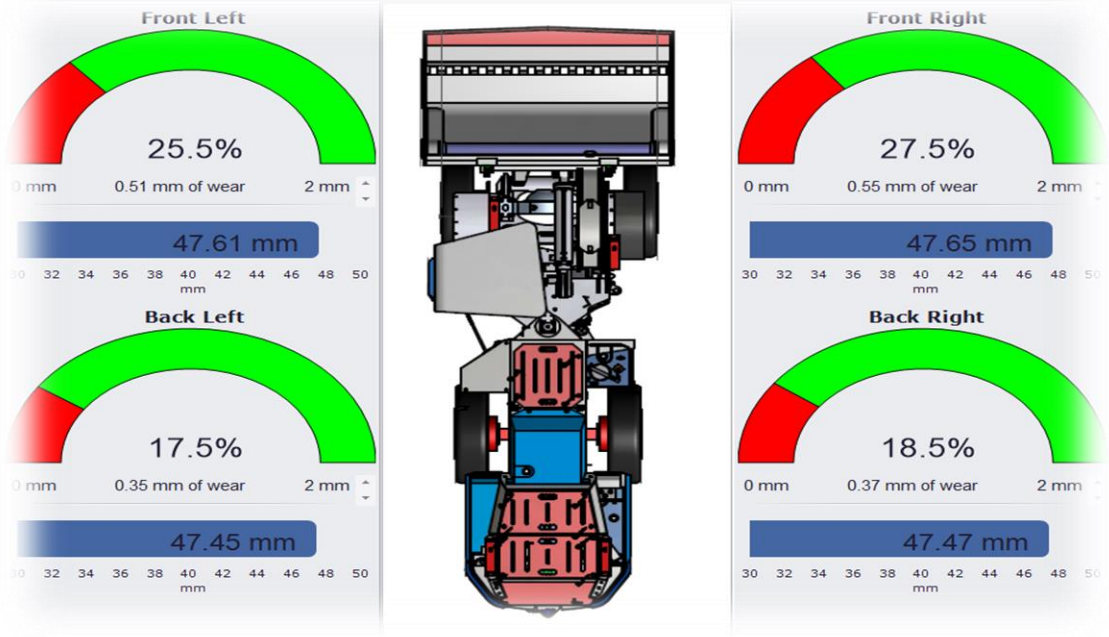
- Chart represents data collected from a LHD over a period
- Y-Axis is scaled in mm, as you would read with a depth gauge Vernier on the brake assembly
- X-Axis is scaled in Date / Time,

Each cluster of measurements represents the samples taken during a single SHIFT

NeroSpec

Dashboard Display

Previous

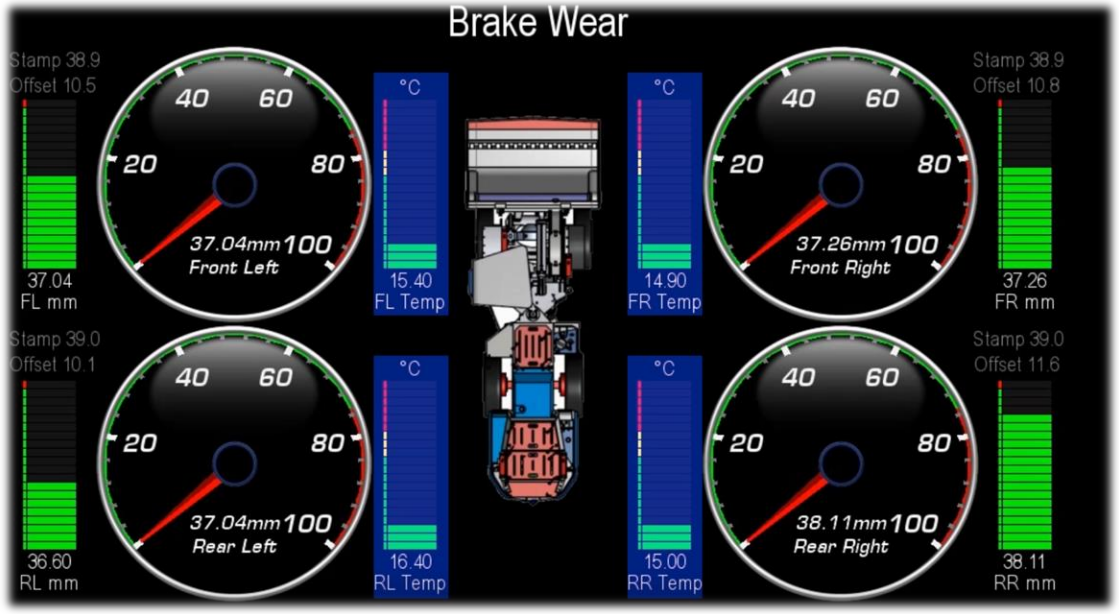


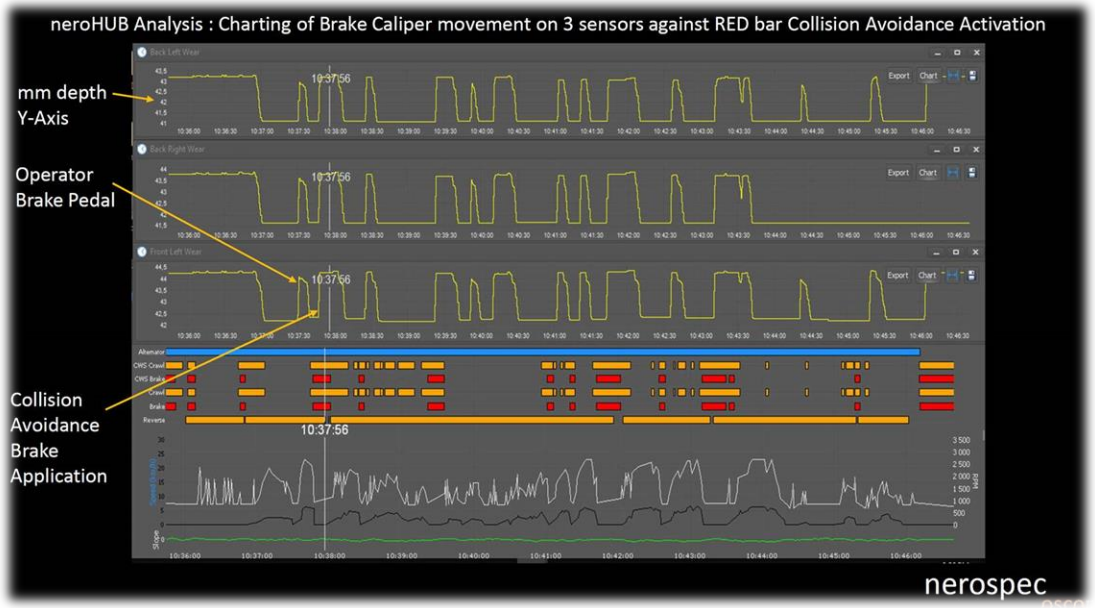
Data can be inspected live and historically from within any of the following user interfaces:

- Operators Screen (if installed)
- Tablet Device Machine Side
- Web Interface
- HUB Analysis Software
- Email report

All records are permanently recorded in the HUB database.

Improved View

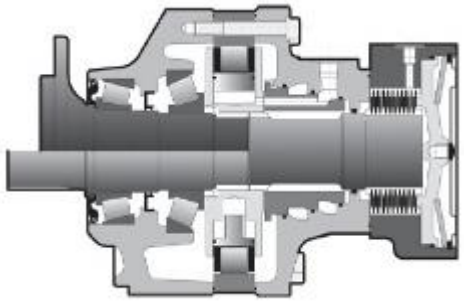


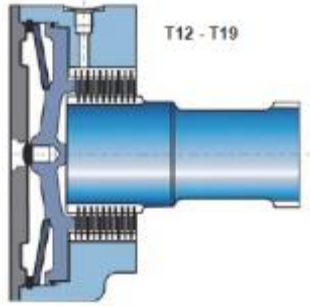


Hydrostatic Drives – Different Approach

Improved OEM Brake Hubs

- OEM brake hub with thicker plates
- Increased wear range





Improving method of brake application

- Hydrostatic braking then Mechanical braking to reduce stress on mechanical components

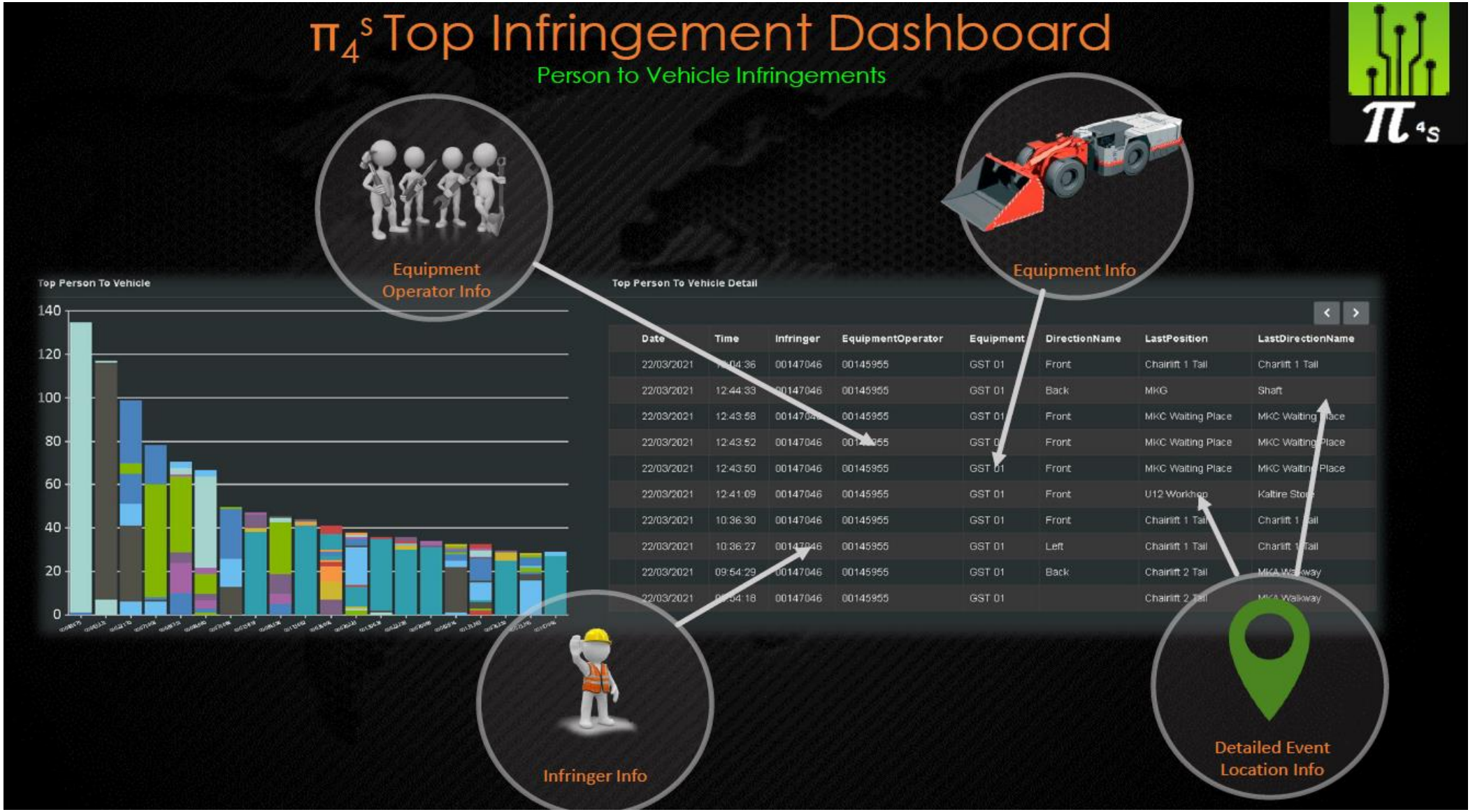
OEM designed valve block – to provide effective crawl

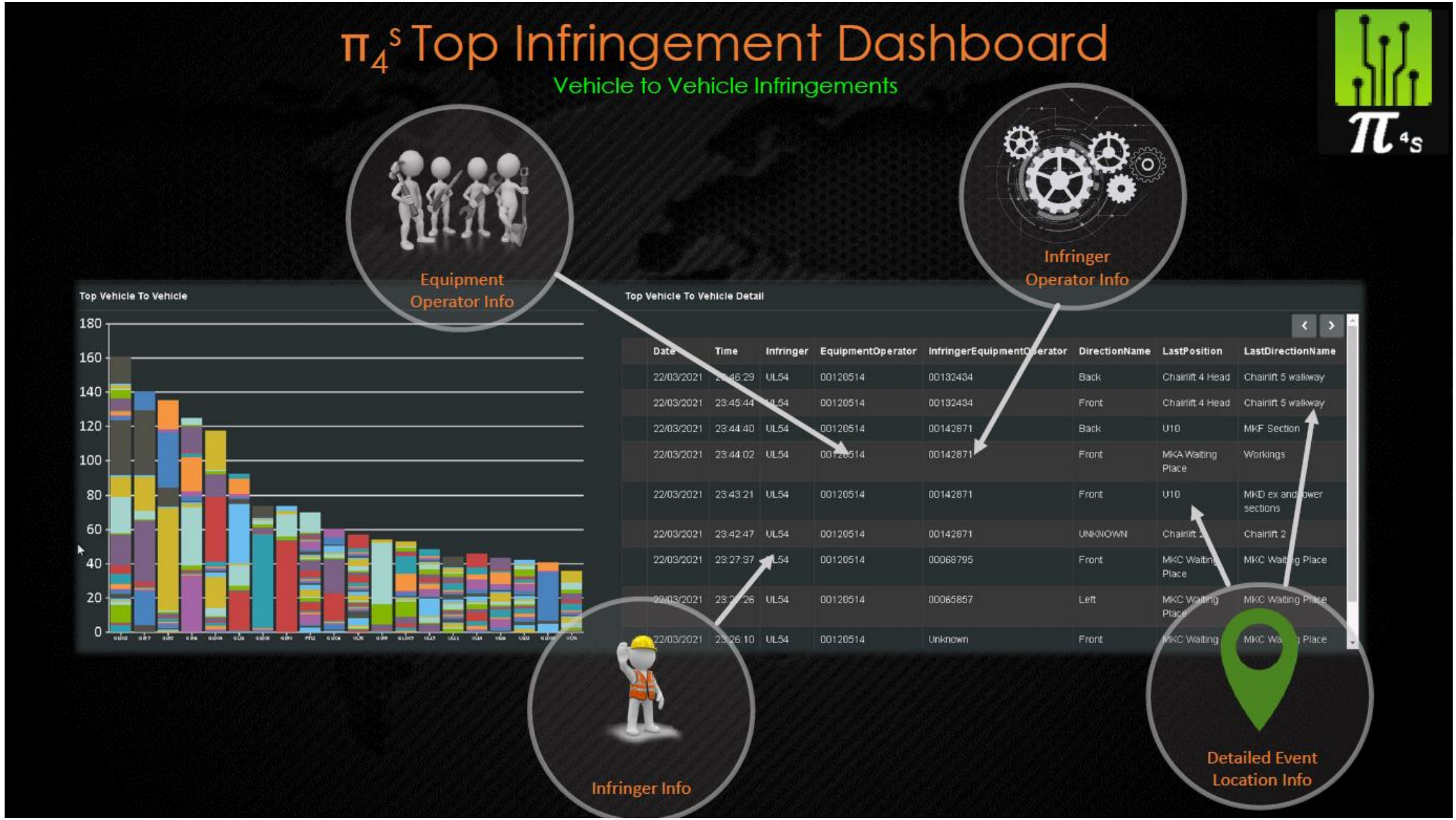
- Valve block limits pilot pressure to joystick to provide pull power at reduced speeds

RHAM

The Digital Mine Map

Digital Mine Map - Benefits




π4S Top Infringement Dashboard
Vehicle to Vehicle Infringements
Equipment Operator Info
Infringer Operator Info
Top Vehicle To Vehicle
Top Vehicle To Vehicle Detail
Date
Time
Infringer
EquipmentOperator
InfringerEquipmentOperator
DirectionName
LastPosition
LastDirectionName
22/03/2021 23:45:44 UL54 00120514 00132434 Front Chairlift 4 Head Chairlift 5 walkway
22/03/2021 23:44:40 UL54 00120514 00142871 Back U10 MKF Section
22/03/2021 23:44:02 UL54 00142871 Front MKA Waiting Place Workings
22/03/2021 23:43:21 UL54 00120514 00142871 Front U10
22/03/2021 23:42:47 UL54 00120514 00142871 UNKNOWN Chairlift 2
22/03/2021 23:27:37 UL54 00120514 00068795 Front MKC Waiting Place
22/03/2021 23:26:10 UL54 00120514 Unknown Front
Infringer Info
Detailed Event Location Info

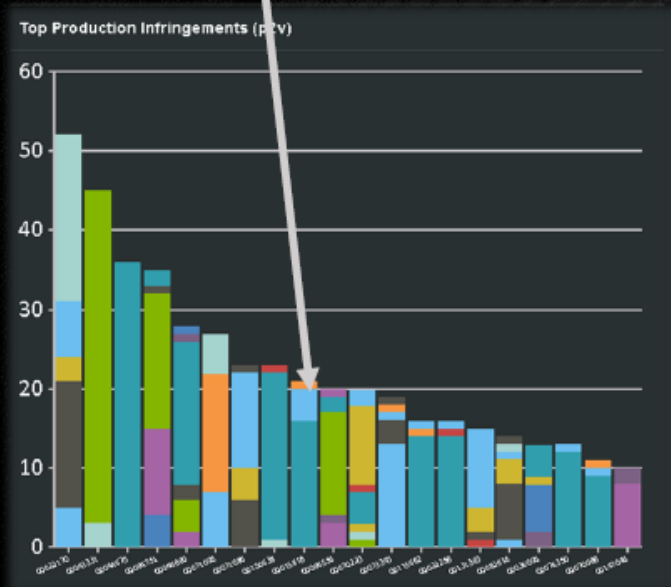
π_4^S Location Based Infringement Dashboard

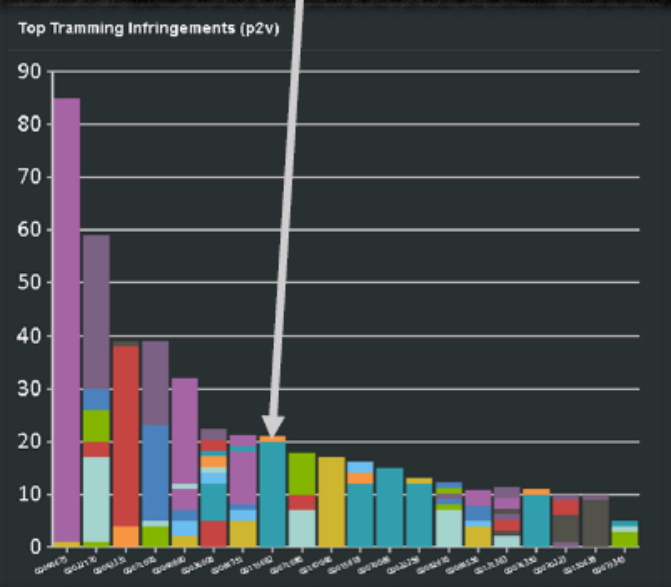
Person to Vehicle Location Derived Process Based Categorization

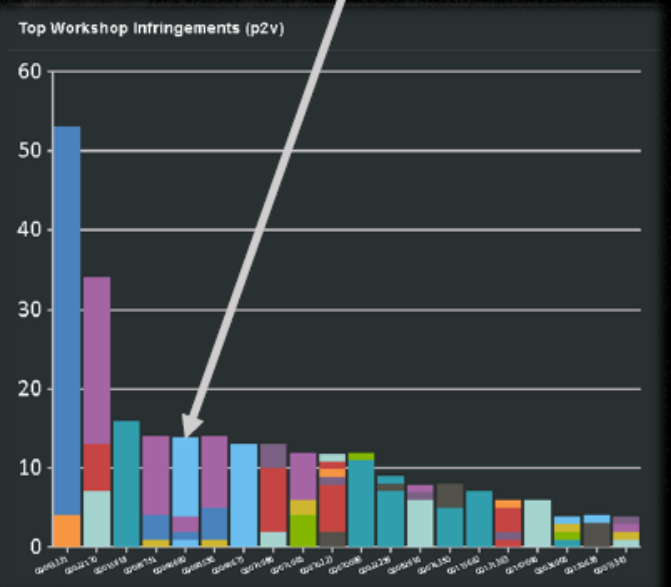
Production Infringements

Tramming Infringements

Workshop Infringements







π_4^s Location Based Infringement Dashboard

Data Filtering

Infringement type Location Filtering

Location Based Filtering

Equipment Type Filtering

Direction

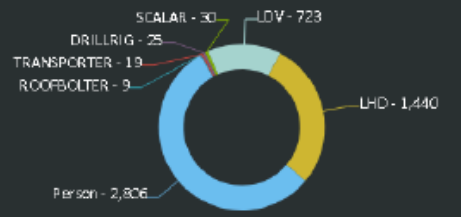
Last Zone Direction

- U12 Workshop
- MKC Waiting Place
- MKF Section
- U12 Transfer main area
- Kaltire Store
- MKB MKE sections
- MKA Waiting Place
- Chairlift 1 Tail
- Chairlift 2 Walkway

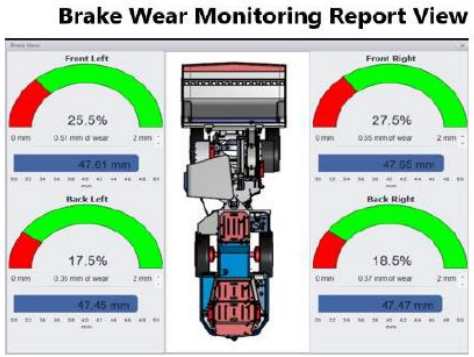
Last Zone Position

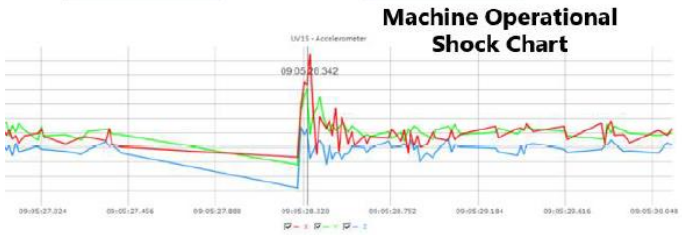
- Chairlift 1 Tail
- Chairlift 2
- Chairlift 2 Tail
- Chairlift 4 Head
- Lamproom
- MKA Waiting Place
- MKC Waiting Place
- MKG
- U10

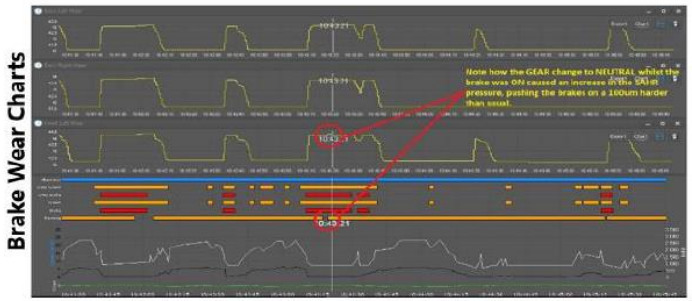
Equipment Type Filter

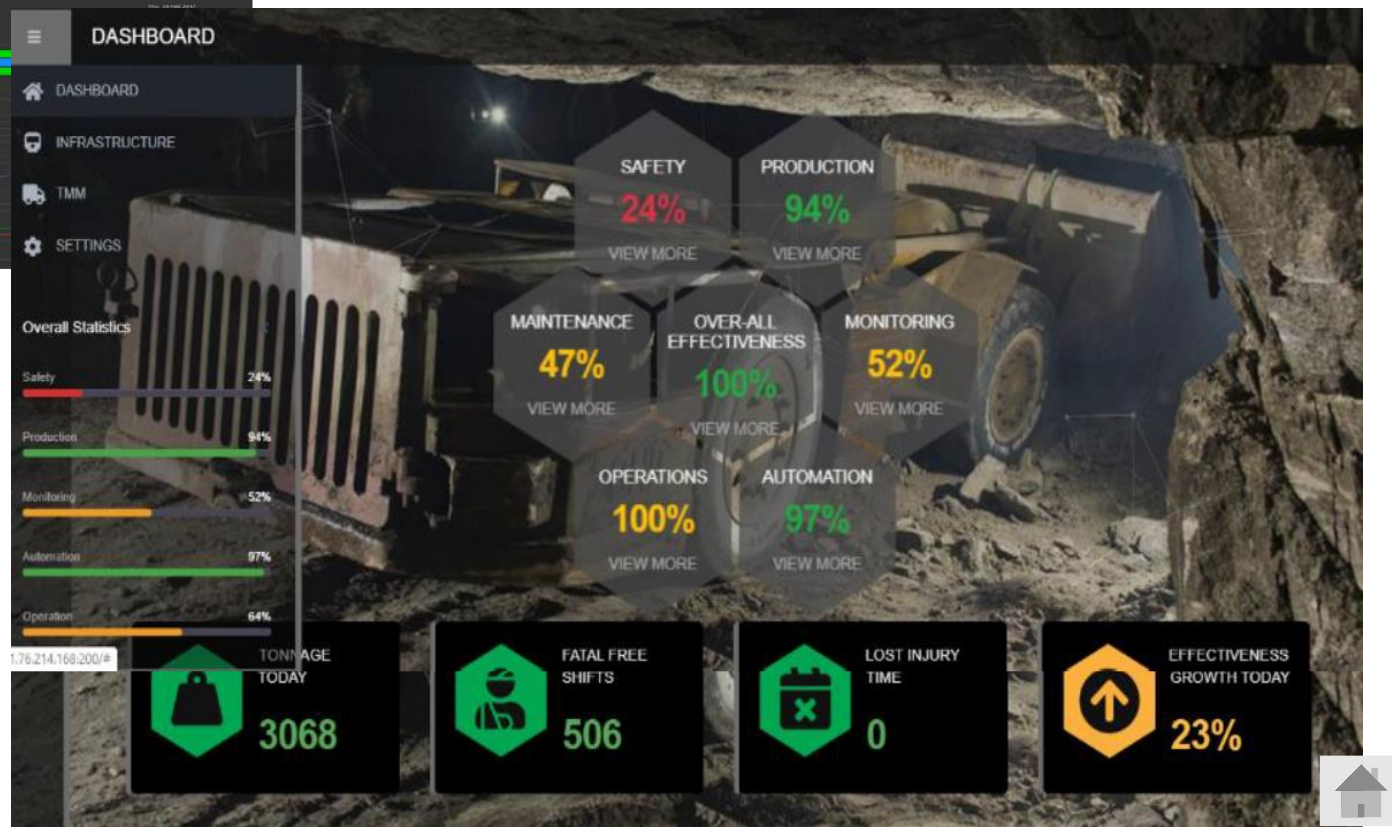


Connecting Machines









- Real Time Data
- Analysis
- Predictive Maintenance

GLENCORE

“We expect safe work, if it is not safe stop work”

“No more fatalities”