

BARRICK

Mining our Mobile Data

NYSE : GOLD
TSX : ABX

World class mines.
World class people.

Remote Monitoring Service - Loulo Operations Extended Field Trial



What are we sharing?



- The trial
- The obstacles
- The benefits
- An example of the partnership
- Where are we going next

Why do a trial?



- An initial 12 month trial at our Loulo Underground Complex in Mali which consists of the Gara and Yalea Underground operations approx. 7 km apart where we mine 2.8Mt pa of ore and approx. 12km p.a. of total development, with LHOS methods.
 - The core fleet comprises:
 - 9 x Sandvik LH621i's
 - 11 x Sandvik TH663i's
 - 5 x Sandvik DD421's
 - 5 x DL421/DL432i
 - Initially the trial was for the Load and Haul fleet only.
 - After 12 months we had seen enough positive impact to continue the trial for a further 12 months
 - In the next 12 months we started to extend the trial to parts of the drill fleet
-

How does it work



- RM services work with the Barrick on site Maintenance Teams, supported by Sandvik PSS team onsite, to maintain the connectivity and provide technical support for the recommendations sent by the RMS team.
- The recommendations comes in various forms:
 - Ad Hoc Maintenance Tasks
 - Ad Hoc Operator Guidance
 - Operator Score cards
 - Defect based Planned Maintenance

Actionable information

Report for with cause-effect and recommendation for maintenance issues

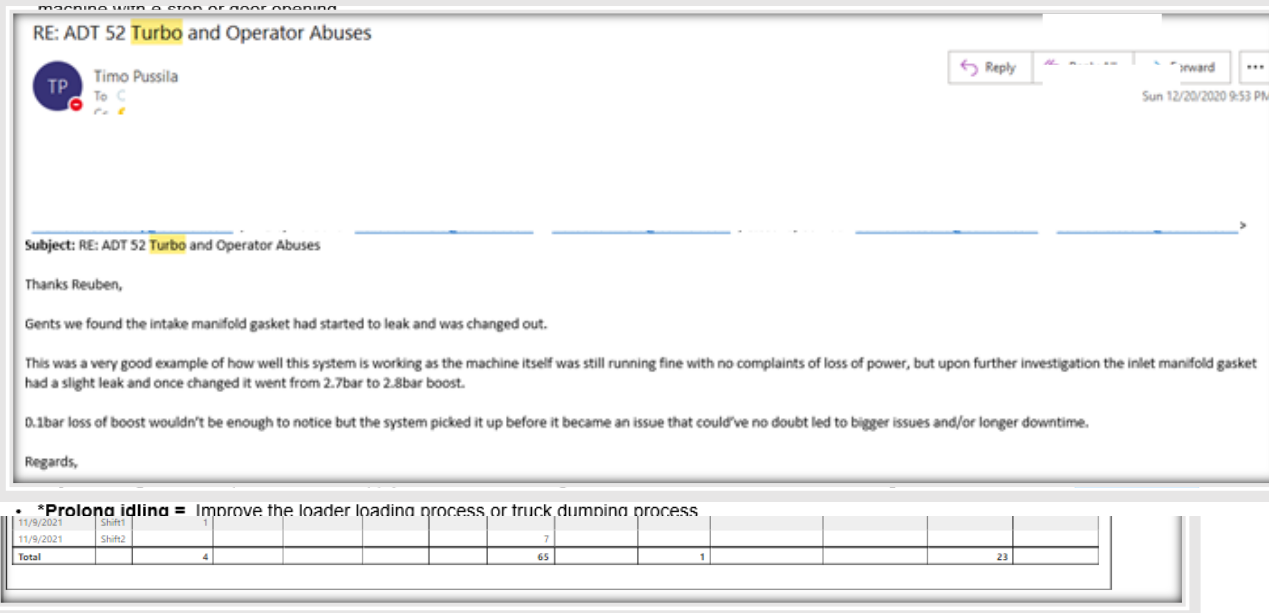


Operator scorecards with competence development items on shift level.

UNIT VIOLATIONS & RECOMMENDATIONS

REMEDY FOR THE VIOLATIONS

- **Hot engine shutdown & hot turbo shutdown** = Guide operator to wait that turbo cooldown timer time elapses, do not shutdown the



The Obstacles



- Who owns the Data?
 - Will Sandvik use that data to minimise warranty claims?
 - Organisational Factors During the Initial 12 month trial there was some resistance to acting on the data
 - The Operations Teams using the data to correct Operator behaviours
 - Operator Competency
 - The Maintenance Teams following up on the corrective actions being provided by RMS team
 - IT systems underground we needed to upgrade as we wanted the ability to see live data, hence we needed more Access points.
 - We have not been able to reduce all the quantity of alarms per operating hour across all the priority areas being monitored and we have not been able to correct Operator Performance – it hasn't resolved all issues
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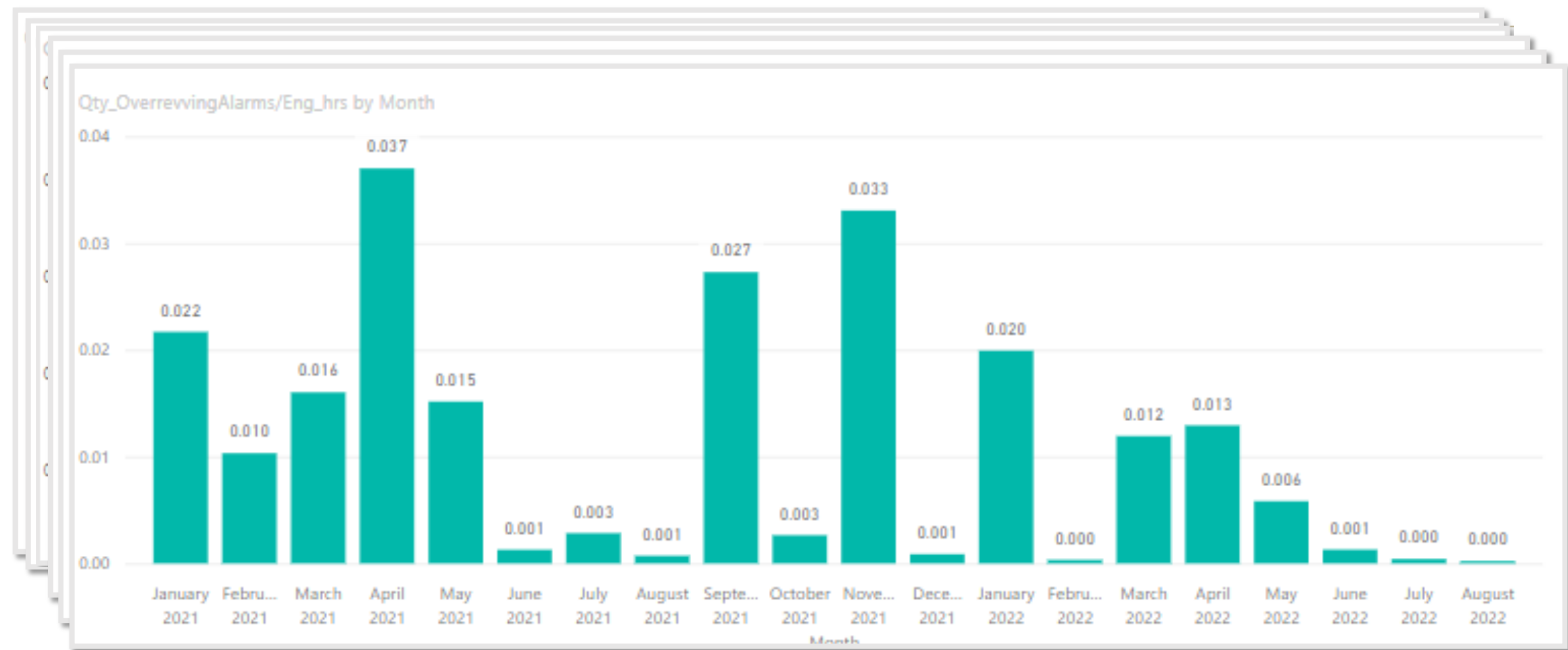
The Key Benefits



- Visualisation of the data to quickly see trends and act on them and be more preventative.
 - Operator behavioural issues
 - Machine Health

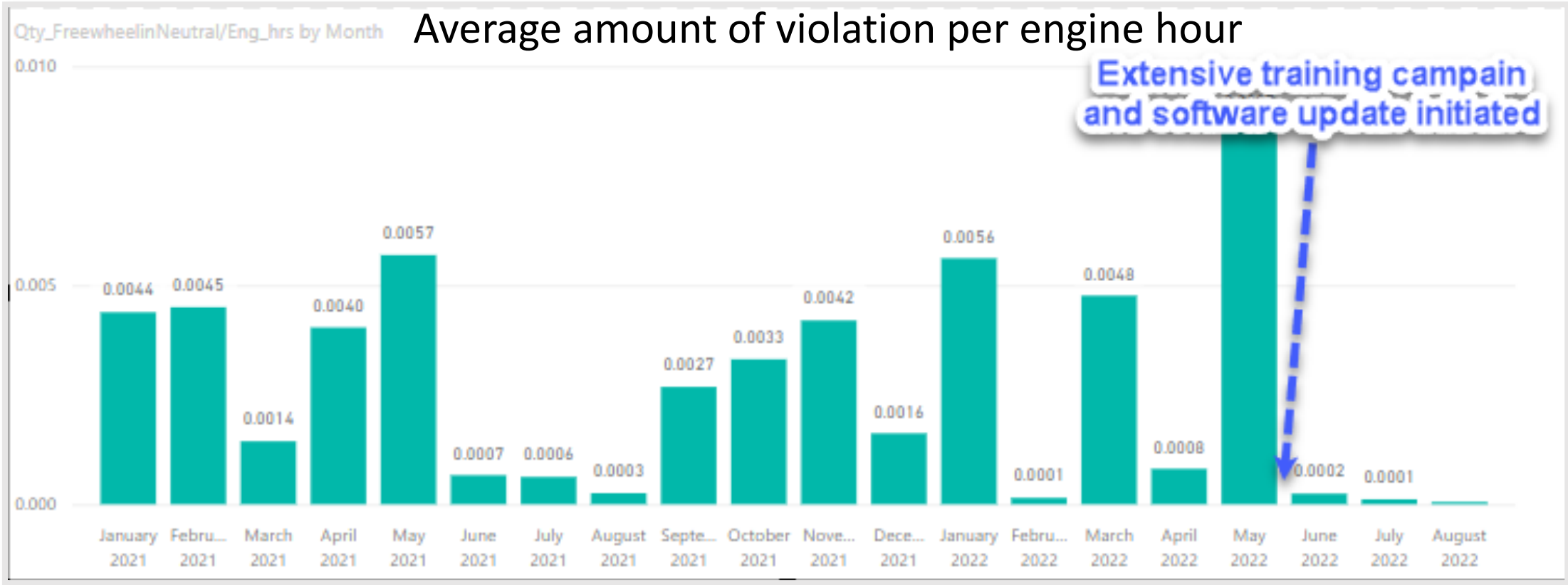
The Key Benefits

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Trucks: Freewheeling in Neutral

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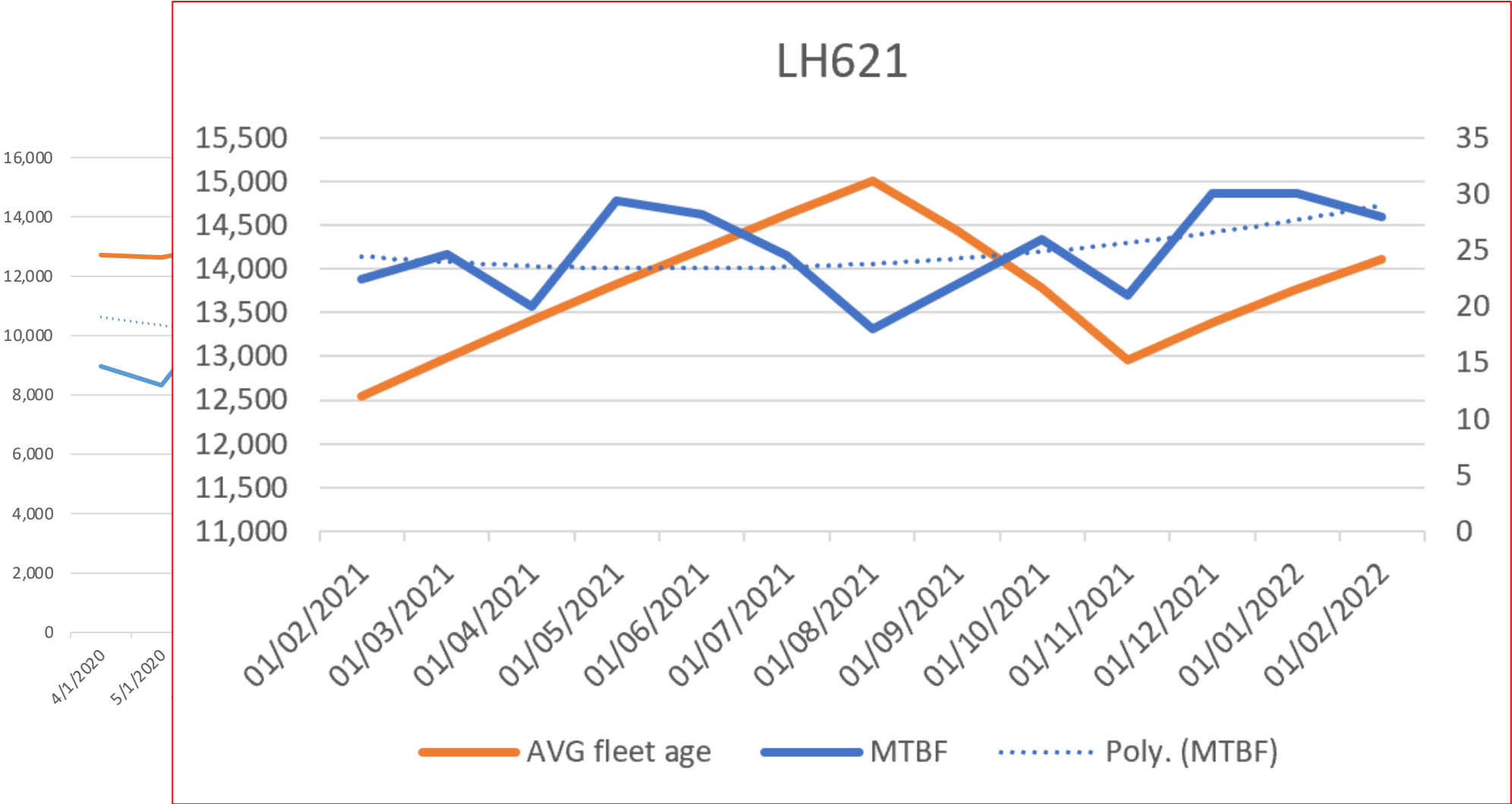
- Freewheeling = *Risk of over speeding, Damages transmission*
- Freewheeling = *Guide operators to not activate 0 gear when machine is in motion.*

The Key Benefits

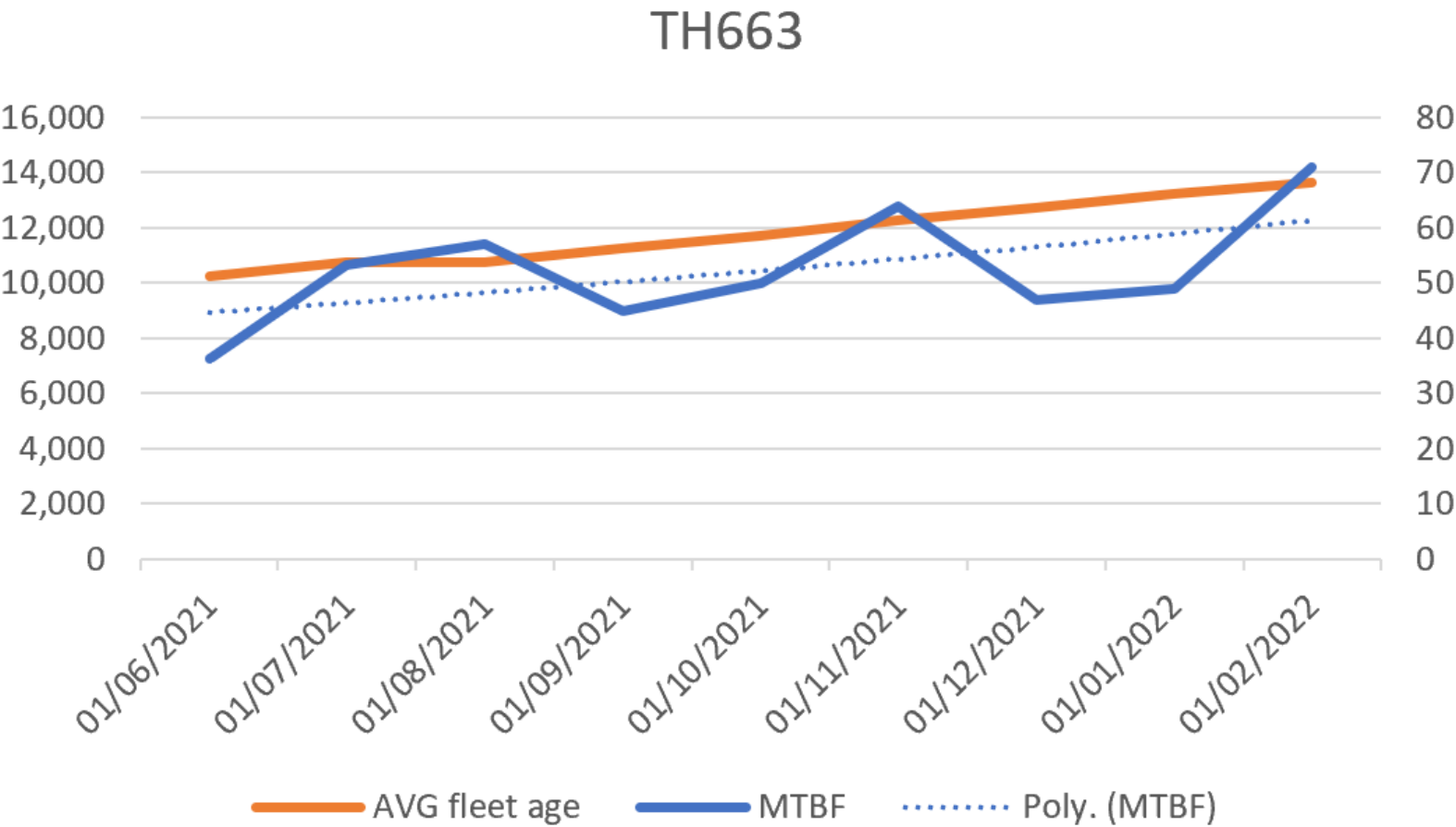
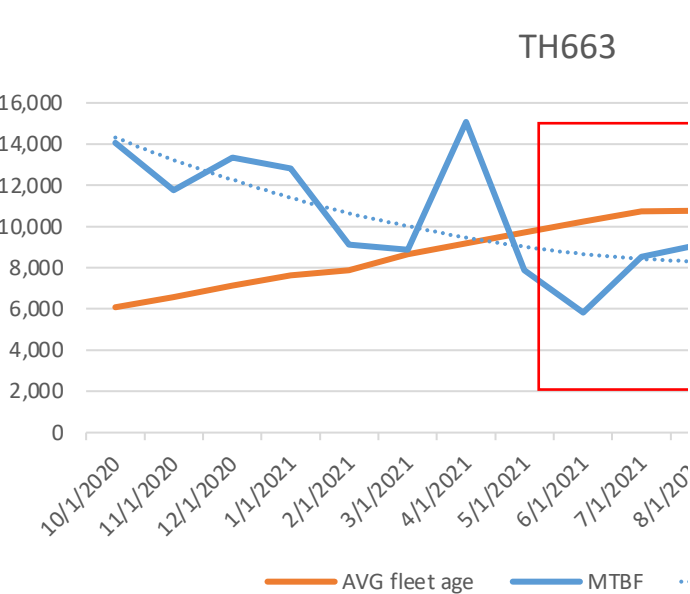


- Visualisation of the data to quickly see trends and act on them and be more preventative.
 - Operator behavioural issues
 - Machine Health
 - Alerts overall trend down, especially in the more critical aspects.
 - MTBF starting to increase
-

MTBF – LH621's



MTBF – TH663's

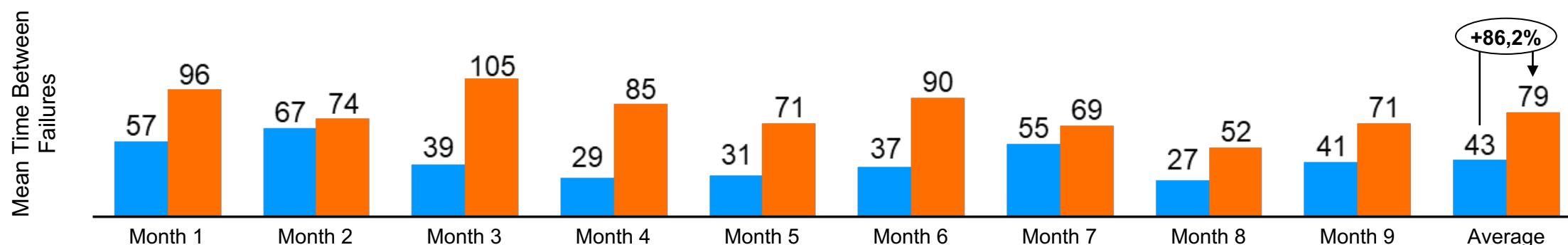


Remote Monitoring Service

LOULO TH663 TRUCKS 2017 WITHOUT SERVICE 2020 WITH SERVICE

Before
After

7 TH663i fleet with average 3000 h age over 9 months without and with RMS:



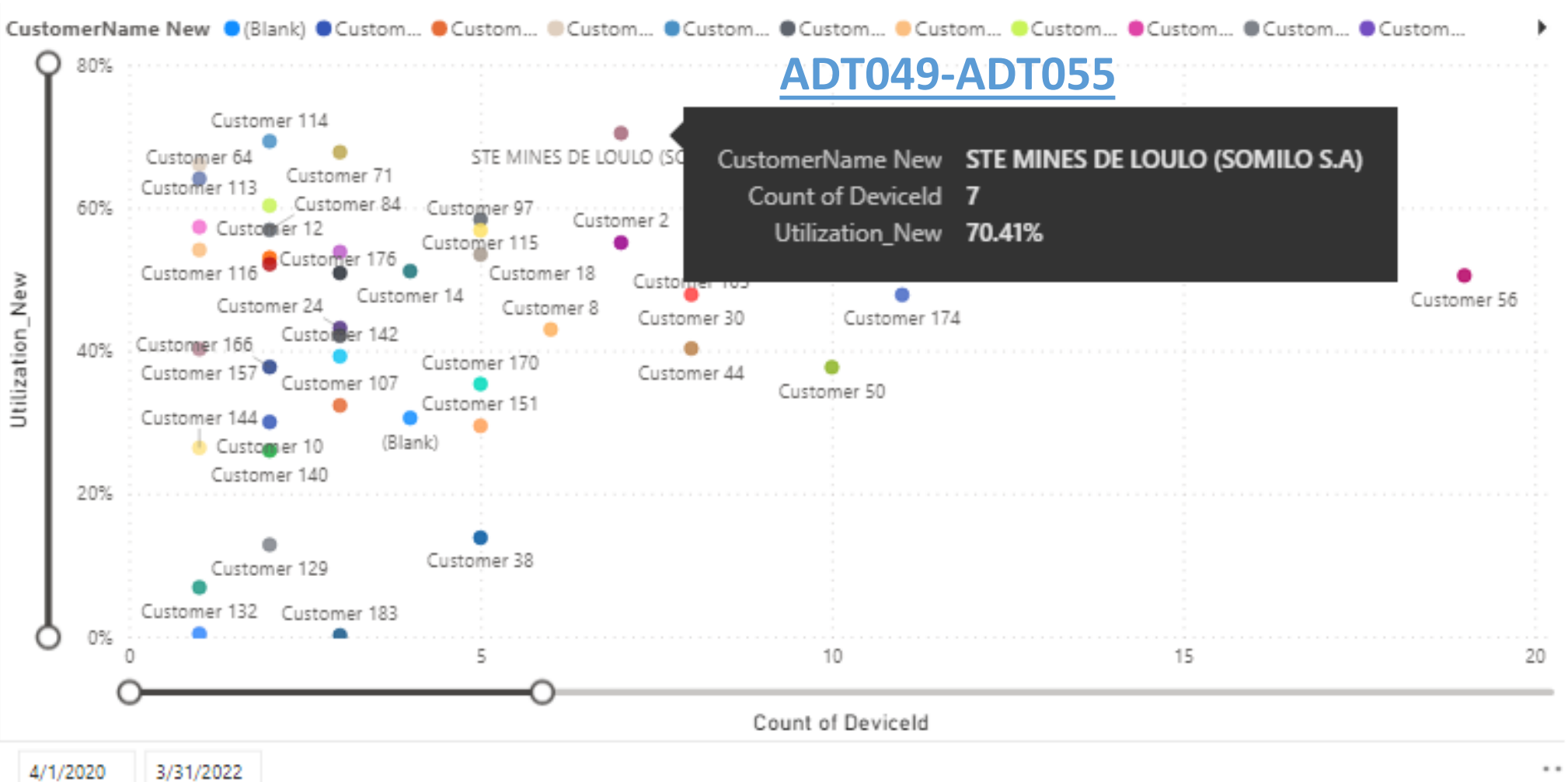
KPIs	Without RMS	With RMS	Difference
Cumulative engine hours	28268 h	32540 h	+15%
Number of Breakdowns	707	426	-40%
Cost Per hour	27,51 USD/h	18,64 USD/h	-32%

The Key Benefits



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 - Utilisation and hence productivities increasing
-

Global TH663 utilization benchmarking

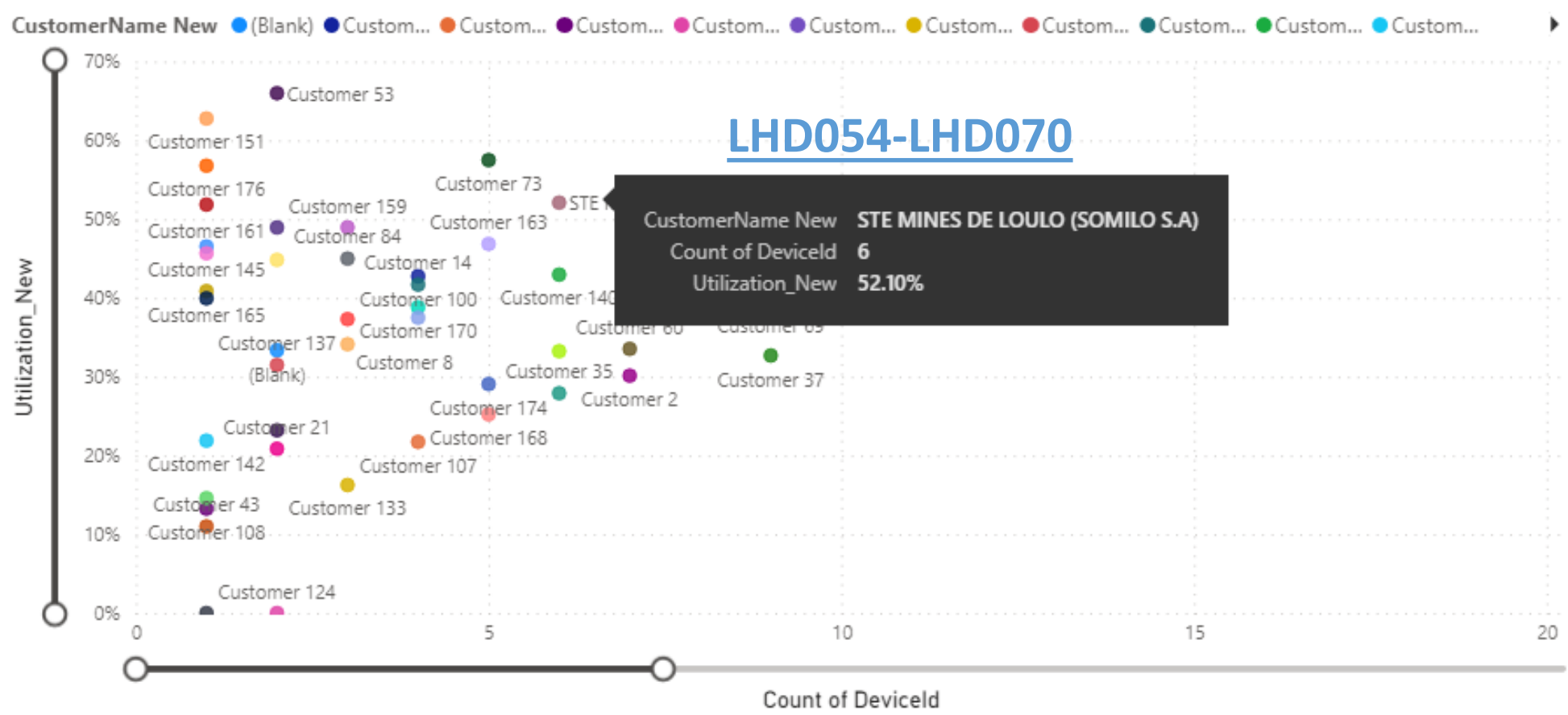


April 2020 –
April 2022

Utilization =
Engine hours/
Calendar
Hours

Loulo is
number 1

Global LHD utilization benchmarking



4/1/2020

3/31/2022

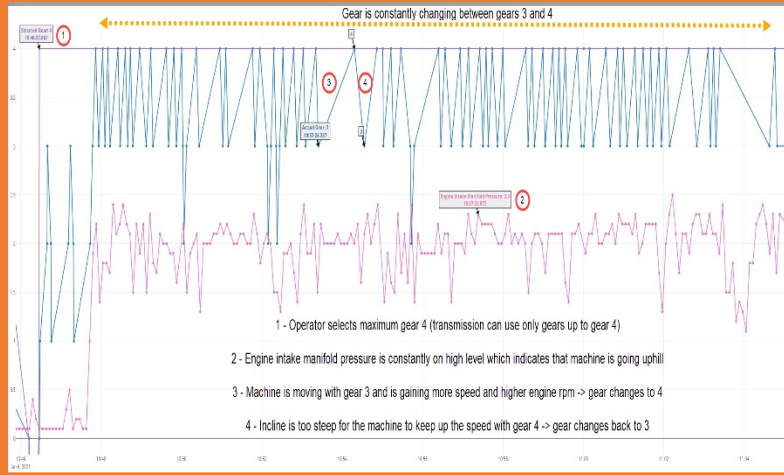
The Key Benefits



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 - Partner with Sandvik on Engineering controls in problematic areas
-

Solving our Problems together.

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- Trend of early transmission failures at TH663 Allison. Feedback provided to Sandvik.

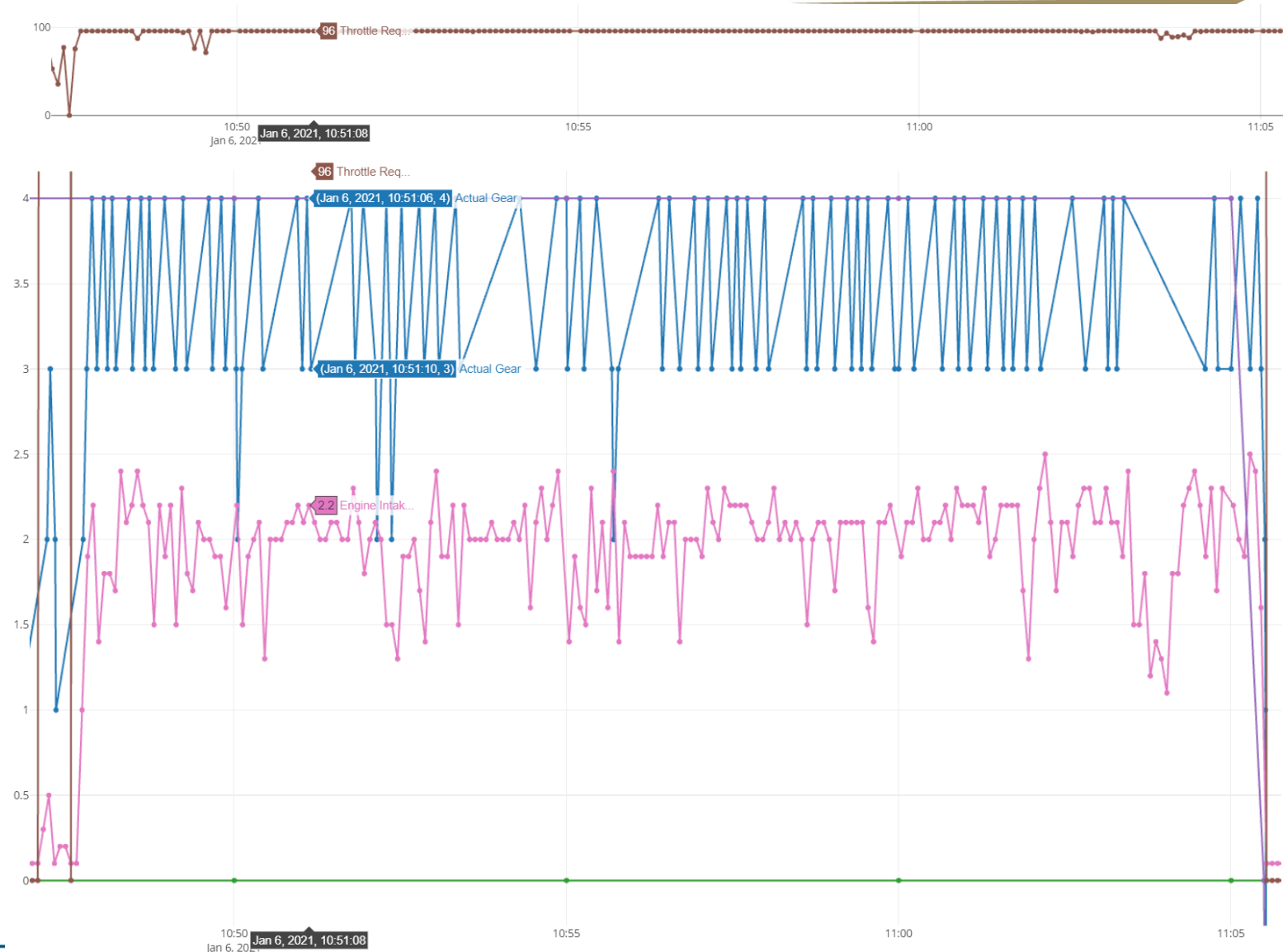
- Sandvik RMS team identified incorrect max gear selection when driving uphill loaded, which caused too frequent gear shifting (3 to 4) and extensive damage to transmission. "Pendulum Shifting".

- Sandvik Engineering teams created control system update to automatically select optimal max gear when driving uphill loaded.
- Software was tested and rolled out to Barrick Loulo fleet.

The Issue

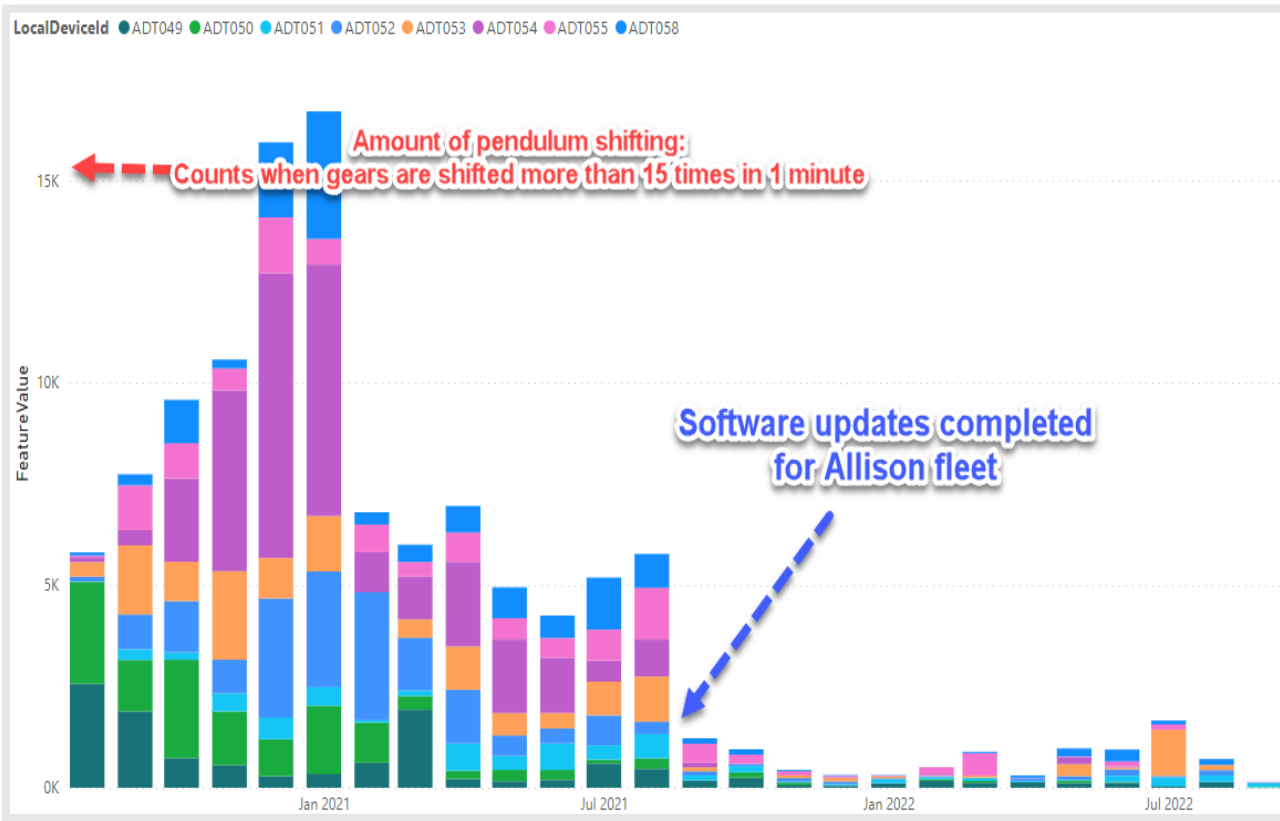
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- Below is an example of pendulum shifting during one shift. Selected max gear is 4 and shift pendulums between 3-4.
- If gear is shifted more than 15 times in minute it is counted as pendulum shifting
- 910 pendulum shifting per one shift
- Gear changes between 3-4 over 100 times during 15-20 minutes time period
- Shortest time period between gear changes is only 4 seconds

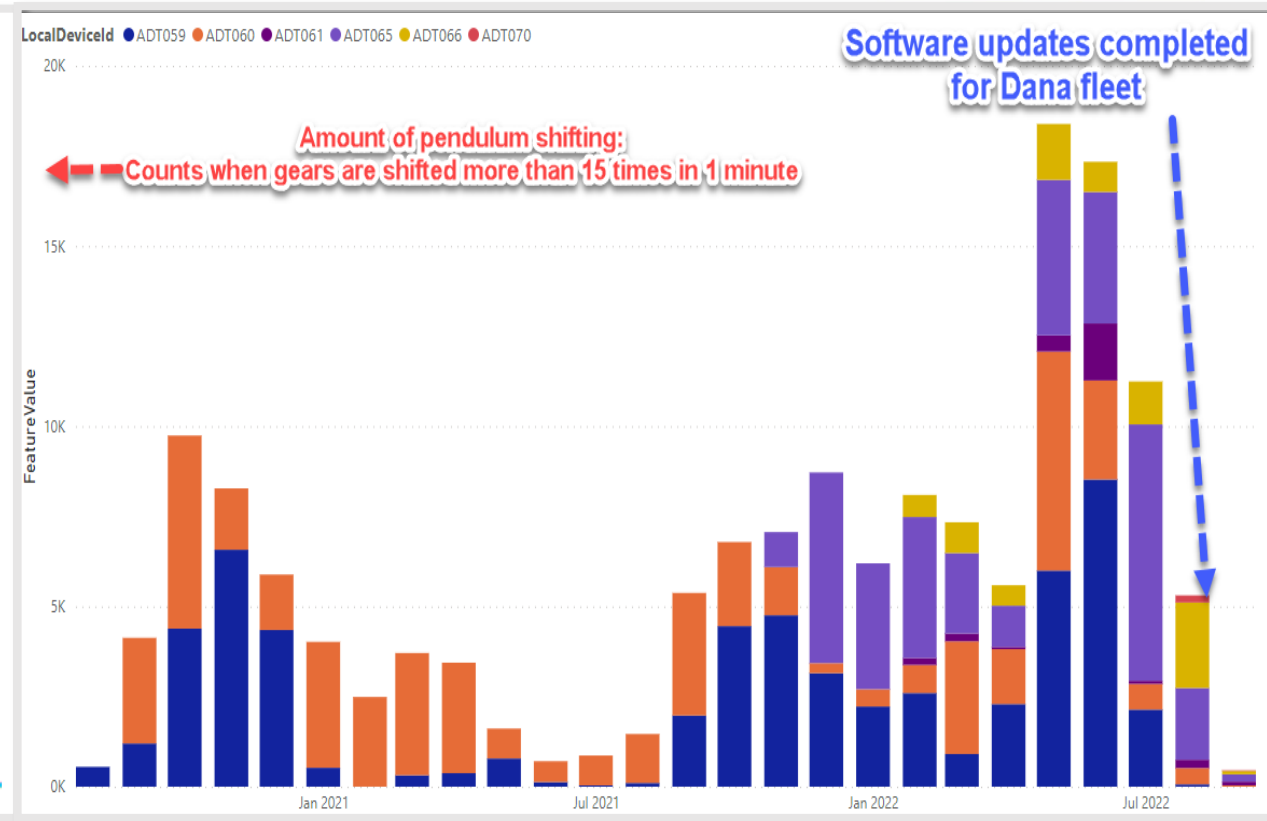


The results

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TH663 Allison



TH663 Dana

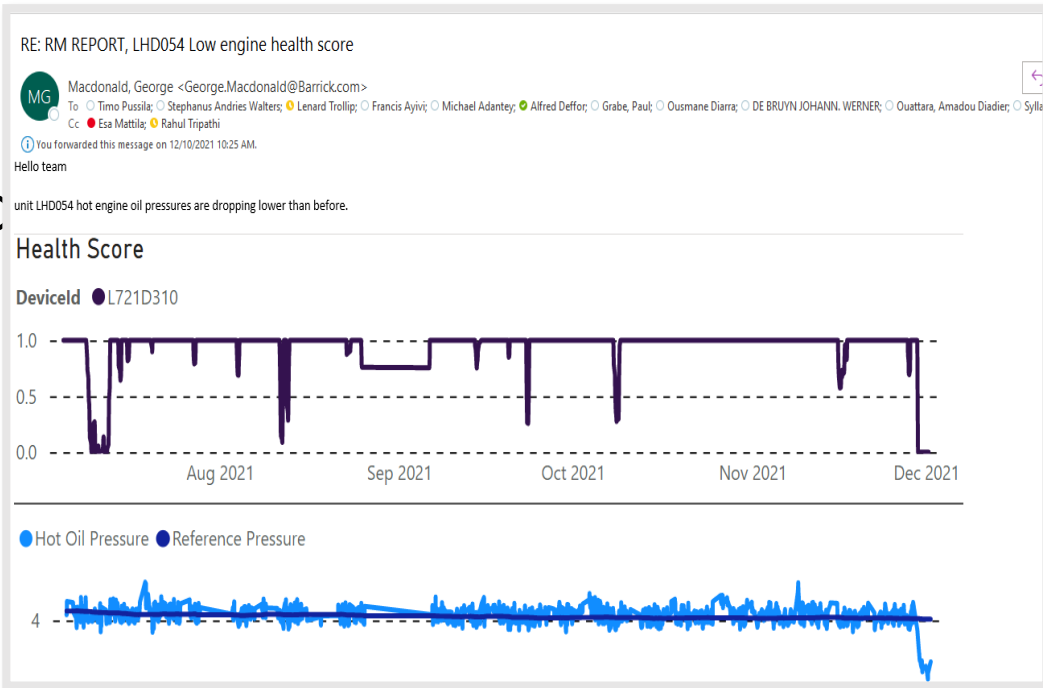
Software updates was first designed and executed to Allison, since majority of the fleet was Allison at the time when issue was identified.

The Key Benefits



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 - MTBF starting to increase
 - Utilisation and hence productivities increasing
 - Partner with Sandvik on Engineering controls in problematic areas
 - **Allows us to start to move to a Predictive Maintenance model.**
-

Moving the needle to Predictive




RE: RM REPORT, LHD054 Low engine health score


Macdonald, George <George.Macdonald@Barrick.com>
To: Timo Pussila; Stephanus Andries Walters; Lenard Trollip; Francis Ayivi; Michael Adantey; Alfred Deffor; Grabe, Paul; Ousmane Diarra; DE BRUYN JOHANN. WERNER; Ouattara, Amadou Didier; Sylla
Cc: Esa Mattila; Rahul Tripathi
You forwarded this message on 12/10/2021 10:25 AM.

Hi Timo,

We dropped the oil sump off and found a lot of silicone stuck in the oil pump pick up screen and have removed and oil pressure came up to 3.6 Bar hot idle & 7 Bar high idle.

Regards,

 Senior Maintenance Forman Mobile Fleet
Underground Engineering Department
T: 2566
M



EVENT :

- This event was identified 10/12/2021 and addressed to site.
- Site acted immediately which resulted in minimal downtime
- Too low engine oil pressure due oil pump would have cause catastrophic engine failure, estimated down time 24 hours.
- Cost of an engine :- € 56,974 EUR
- Estimated downtime cost: 14,344 €/h * 24 hours = € 344,250

DOWN TIME COST ESTIMATION LOADERS:

By using estimation of 5 bucket per hour with grade of 5g/ton:
Average bucket load $((15 \text{ ton} * 5) * 5g) * 45\text{€g}^{-1} * 0.85 =$
€ 14,344 EUR