DATA-DRIVEN SOLUTIONS FOR RAILWAY EXCELLENCE

WHO TRULY LEADS THE GAME:
BUSINESS SHAPING TECHNOLOGY, OR
TECHNOLOGY REDEFINING BUSINESS?

HIGHLY OFFSHORED ACTIVITY
ADVANCED ANALYTICS FOR CRITICAL COMPONENTS

+20.000
+8.000
+60.000

MASTER CONTROLLER

HVAC

COMPRESSOR

DOORS

PANTOGRAPH

TRACTION CONVERTER

ACR

ENGINE
+800

BOGIE
+20.000

BRAKES

BATTERY

WHEELSET
+40.000 AXLE
+80.000 WHEELS

WE OPERATE IN

20
COUNTRIES

+150
CONTRACTS

+30
SUBSIDIARIES

+100
MAINTENANCE CENTERS

12K
CARS

4K
PEOPLE&TALENT

TECHNOLOGY SERVING BUSINESS

ADDRESSING KEY CHALLENGES OF OPERATORS & MAINTAINERS

SERVICE EXCELLENCE: PUNCTUALITY, AVAILABILITY, SAFETY

Every delay impacts **passenger trust** and **operator reputation**, making reliability non-negotiable.

ASSET OPTIMIZATION: HIGH VALUE, MINIMAL DOWNTIME

Rail assets are expensive and critical. The challenge is: **keep them in service**, not in the workshop.

SMART OPERATIONS: FROM REACTIVE FIREFIGHTING TO PROACTIVE

Seamlessly orchestrating operations through **real-time insights, predictive planning, and smart prioritization**.

DRIVING SOLUTIONS: BETTER DATA, SMARTER DECISIONS

DATA INPUTS FOR SMARTER DECISIONS

GMAO

REAL TIME DATA

1.000 ms

PERFORMANCE VARIABLES

FROM ANY RAIL ASSET : 15-20K

WAYSIDE DATA

AUTOMATIC INSPECTION
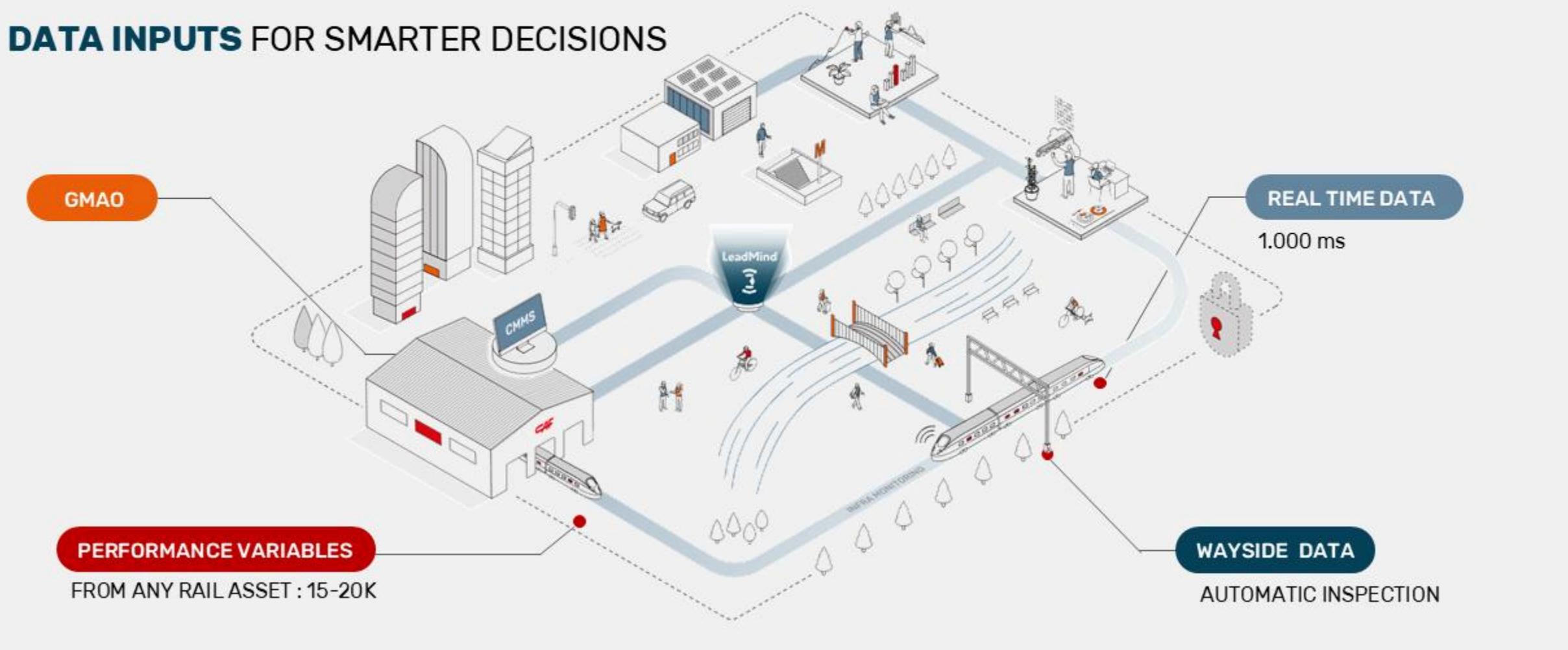
REAL TIME FLEET HEALTH CONTROL:
FLEET STATUS AND ALARMS, EMPOWERING DEPOT & OPERATIONS TEAMS

"LeadMind gives us all necessary operational information regarding the behaviour of the trams, **A QUICK OVERVIEW OF THE FLEET HEALTH**. The advantage is that we get clear, correct, accurate and real time information about the trams. **WE CAN READ THE TRAM FROM A DISTANCE**"

Kees van de Groep, Process Manager Assets Rolling Stock

PROVINCIE # UTRECHT

"Serco Caledonian Sleeper now have the ability to use real time data from LeadMind to monitor the fleet in service to **IDENTIFY ISSUES AND PROVIDE AN IMPROVED LEVEL OF ENGINEERING SUPPORT** to our Train Managers."

Graham Eastwood, Head of Depot Contracts.

CALEDONIAN SLEEPER

"The track to train connectivity allows use of **REAL TIME DIAGNOSTIC** tools through allowing operators and maintainers to provide the **SAFEST AND MOST RELIABLE SYSTEM POSSIBLE FOR THE NETWORK**. Since introduction Canberra Light Rail have enjoyed the use of the real time system and data logging to the benefit of all."

Andrew Pearce, Director Of Engineering Canberra Metro Operations at CMET.

NSW Transport RailCorp
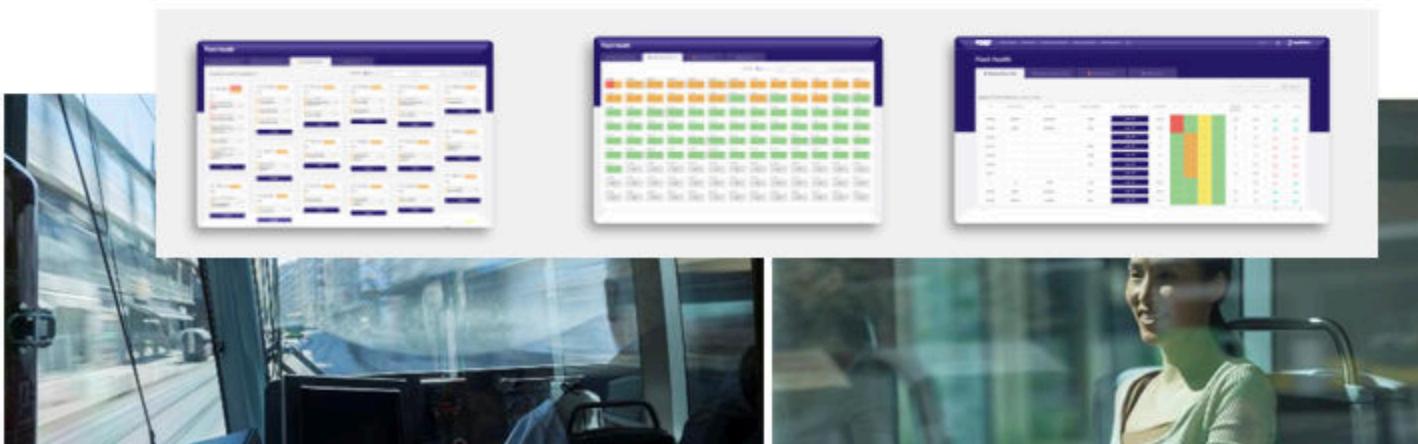
/ REDUCTION OF **OPERATIONAL DELAYS**

/ IMPROVED **OPERATING ASSISTANCE**

/ REDUCTION OF **OPERATIONAL INCIDENTS**

TRANFORM DATA INTO BUSINESS BENEFITS:
OPERATIONAL INSIGHT FOR MULTIPLE NEEDS

EFFICIENCY - DRIVER PERFORMANCE

CAPACITY MANAGEMENT - PASSENGER OCCUPANCY

SAFETY – SPEED MONITORING

SAFETY – WHEEL SLIP

ENERGY EFFICIENCY

MANAGEMENT, CONTROL & ANALYSIS

DRIVING STRATEGIES

CATENARY RECEPTIVITY

OUT-OF-SERVICE TRAIN ENERGY
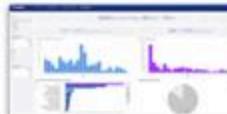
SAFETY – SPEED MONITORING

"We are delighted to be working with CAF, to introduce this leading-Edge technology to alert our drivers to **overspeed conditions**. The alerts will allow the driver to react and control the tram vehicle thereby enhancing our already safe operation to human error events"

Colin Kerr, Head of Safety & Projects.

SAFETY – WHEEL SLIP

"**Operational safety** is the most important aspect of UK railways, and LeadMind enables a **more controlled, digital approach**. We use wheel rotations to determine safe door operation and identify low adhesion areas. The wheel slip dashboards highlight hotspots, allowing Network Rail teams to clean the rails and prevent future issues."

David Curtis, Onboard Systems Service Delivery Manager at Northern

THE PATH TO PREDICTIVE EXCELLENCE

DATA-DRIVEN PERFORMANCE IS ACHIEVED BY INTEGRATING **TECHNOLOGY**, **CULTURE**, **PROCESSES**, AND **PEOPLE**

PREDICTIVE MAINTENANCE

DYNAMIC PLANNING:
SMS: SMART MAINTENANCE SCHEDULER

EVENT CONNECT
CONDITION BASED MAINTENANCE

CBM
CONDITION BASED MAINTENANCE

SMART ALARMS
INTELLIGENT INSIGHTS

TRAIN ALARM FEED
DATA INPUT

Provide the workshop with a **smart, condition-based maintenance planning system** designed to:

- Optimize maintenance scheduling

- Reduce planning complexity

- Minimize maintenance contract costs

- Improve train availability and reliability

Full autonomy for the workshop to define and configure HMI and CBM events and open Work Orders.

Maintenance Strategies Based on Real Asset Health

Prioritized Alarm Management for Data-Driven Maintenance Decisions

Centralized Monitoring of Fleet Health and Alarm

ACTREN

CPTM

"There is a real commitment to the digital transformation with LeadMind, CAF's digital platform. It is allowing us to perform real-time asset maintenance as well as advanced analytics for predictive and condition-based maintenance."

"In the short term we have had very relevant results. In addition, the tool is intuitive and easy to use and the different functionalities show the data at a glance. LeadMind makes day-to-day work more dynamic and decision making easier. Moreover, as time goes by, you gain expertise (knowledge) and the benefits get better and better."

Gorka Macías
Maintenance Engineering Director.

actren

Cleverson Rodrigues
Operations Director at Ctrens

CPTM

RELIABILITY IMPROVEMENT

Fleet	Improvement
S/120 Fleet →	**53%**
S/120.5 Fleet →	**97%**
S/121 Fleet →	**137%**

EVOLUTION OF REPAIR TIME FOR CRITICAL SYSTEMS

■ Total Corrective Hours
□ Critical Components Time To Repair

(bar chart: OCT. 22, NOV. 220, IC 22, JAN 23)

/ LEADMIND HAS DELIVERED SIGNIFICANT BENEFITS AND SAVINGS IN CORRECTIVE ACTIONS IN JUST FOUR MONTHS

15% IMPROVEMENT
In the total number of failures due to the anticipation of failures through early corrective actions.

| SAVINGS	IMPROVEMENT	REDUCTION
44%	**50%**	**20%**
In the used materials due to anticipation before catastrophic breakdowns occur which involves high cost of materials.	Mean time to repair (a reduction of 8 h to 4 h in the execution of a corrective task)	In hours dedicated to corrective actions

| IMPROVEMENT	IMPROVEMENT	IMPROVEMENT
209%	**69%**	**41%**
IN RB REVISION TIMES (ON AVG)	IN RA REVISION TIMES (ON AVG)	IN MEAN TIME TO REPAIR
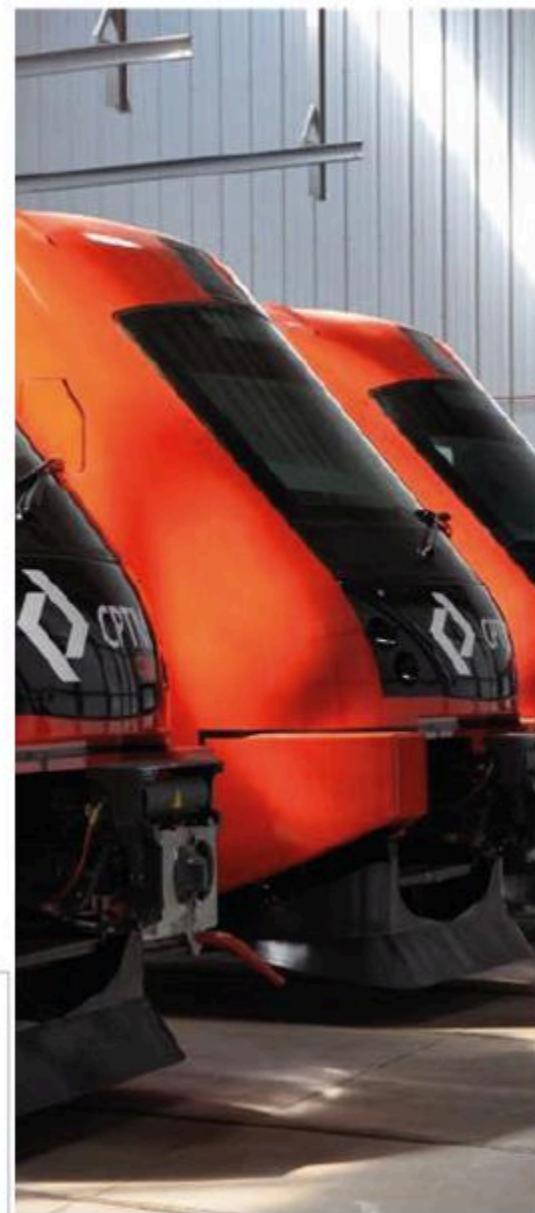
▶ PROACTIVE DATA ACQUISITION FROM KEY ASSETS

NEW DATA SOURCES TO ENABLE PREDICTIVE MAINTENANCE

SAVES

90%

OF THE TIME REQUIRED MANUALLY

Ernst Visser
Technical Manager Assets Rolling Stock
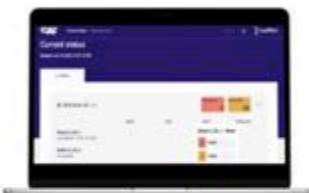
FLEET STATUS
& ALARM MANAGEMENT

MEASUREMENT DETAILS

ADVANCED ANALYTICS
FOR LIFE PREDICTION

VISUAL INSPECTION

CAF
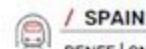
/ SPAIN

RENFE | ONBOARD
TMB | ONBOARD
ACTREN | ONBOARD + WAYSIDE
TRANVIA ZARAGOZA | ONBOARD + WAYSIDE
EUSKOTREN | ONBOARD + WAYSIDE
METRO GRANADA | ONBOARD
METRO CENTRO SEVILLA | ONBOARD

METRO MALAGA | ONBOARD
METRO BILBAO | WAYSIDE
CAP TRAIN | ONBOARD
METRO MADRID
TRANVÍA VITORIA
EMU MALLORCA

/ UK

TRANSPENINNE | ONBOARD
WESTMIDALDS | ONBOARD
WALES & BORDERS | ONBOARD
NORTHERN | ONBOARD
CALEDONIAN | ONBOARD
EDINBOURGH TRAMS | ONBOARD
NIR | ONBOARD
DOCKLANDS | ONBOARD + WAYSIDE

/ SERBIA

SERBIAN RAILWAYS | WAYSIDE

/ ISRAEL

TELAVIV | ONBOARD + WAYSIDE
JERUSALEM | ONBOARD + WAYSIDE

/ ARABIA SAUDI

SAR | ONBOARD + WAYSIDE
METRO RIYADH | WAYSIDE

/ EMIRATES

ETIHAD RAIL | ONBOARD

/ SOUTH KOREA

METRO SEOUL | WAYSIDE

/ TAIWAN

XIDONG TRAM

/ PHILIPINNES

PHILIPPINES NATIONAL RAILWAYS | ONBOARD

/ INDONESIA

INDOSAT ONBOARD + WAYSIDE

/ CANADA

TTC | WAYSIDE
CALGARY TRANSIT | ONBOARD
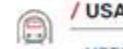
/ USA

MBTA BOSTON | ONBOARD
MERYLAND | ONBOARD + WAYSIDE
OMAHA | ONBOARD
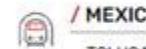
/ MEXICO

TOLUCA | WAYSIDE
LINEA 12 CDM | ONBOARD
SUBURBANO | ONBOARD
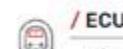
/ ECUADOR

METRO QUITO | WAYSIDE
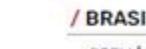
/ BRASIL

CPTM | ONBOARD

/ CHILE

METRO SANTIAGO | ONBOARD

/ AUSTRALIA

PARRAMATA | ONBOARD + WAYSIDE
CANBERRA | ONBOARD

/ NEW ZEALAND

AUCKLAND | WAYSIDE

/ NORWAY

OSLO TRAM | ONBOARD
FLYTOGET | ONBOARD
OSLO METRO

/ SWEDEN

SKANETRAFIKEN | ONBOARD
NORRTAG | ONBOARD
TRANVIA LUND | ONBOARD
GOTHENBURG TRAM | WAYSIDE
SJ | ONBOARD
TRANSITIO | ONBOARD

/ ITALY

TRENITALIA | ONBOARD
METRONAPOLI | ONBOARD
ROMA TRAM | ONBOARD
BOLONIA TRAM | ONBOARD
PALERMO TRAM | ONBOARD

/ PORTUGAL

LISBON TRAM | ONBOARD
OPORTO TRAM | WAYSIDE

/ FRANCE

TRAM MONTPELLIER
TRAM TOURS

/ SWITZERLAND

TPG | WAYSIDE

/ GERMANY

SCHONBUCHBAHN | ONBOARD
VRR | ONBOARD

/ NETHERLANDS

GVB | ONBOARD
UTRECHT | ONBOARD + WAYSIDE
NS | ONBOARD + WAYSIDE
QBUZZ | ONBOARD

/ BELGIUM

LIEJA | ONBOARD
METRO BRUSSELS | ONBOARD

+80
FLEETS

27
COUNTRIES

+2K
UNITS MONITORED

+8K
CARS MONITORED

75
WAYSIDE SYSTEMS

NOTE: The fleets highlighted in blue are scheduled for deployment in the medium term over the coming years

FROM CLOUD TO AI: FUTURE STEPS
THE NEW ERA FOR RAILWAY MAINTENANCE

We start from a privileged competitive position enabled by the LeadMind platform, which includes consolidated maintenance solutions known for:

✓ REAL-TIME FLEET MONITORING: OVER 2,000 UT AND 80 PROJECTS BY 2027

✓ ADVANCED AUTOMATION CAPABILITIES: CLOUD AND AI-DRIVEN

✓ SMART PLANNING ADOPTION

✓ BUILDING PLATFORM TO ACCELERATE DEVELOPMENT AND TIME TO MARKET

✓ ESTABLISHED DATA GOVERNANCE

✓ DIGITAL TECHNICIAN
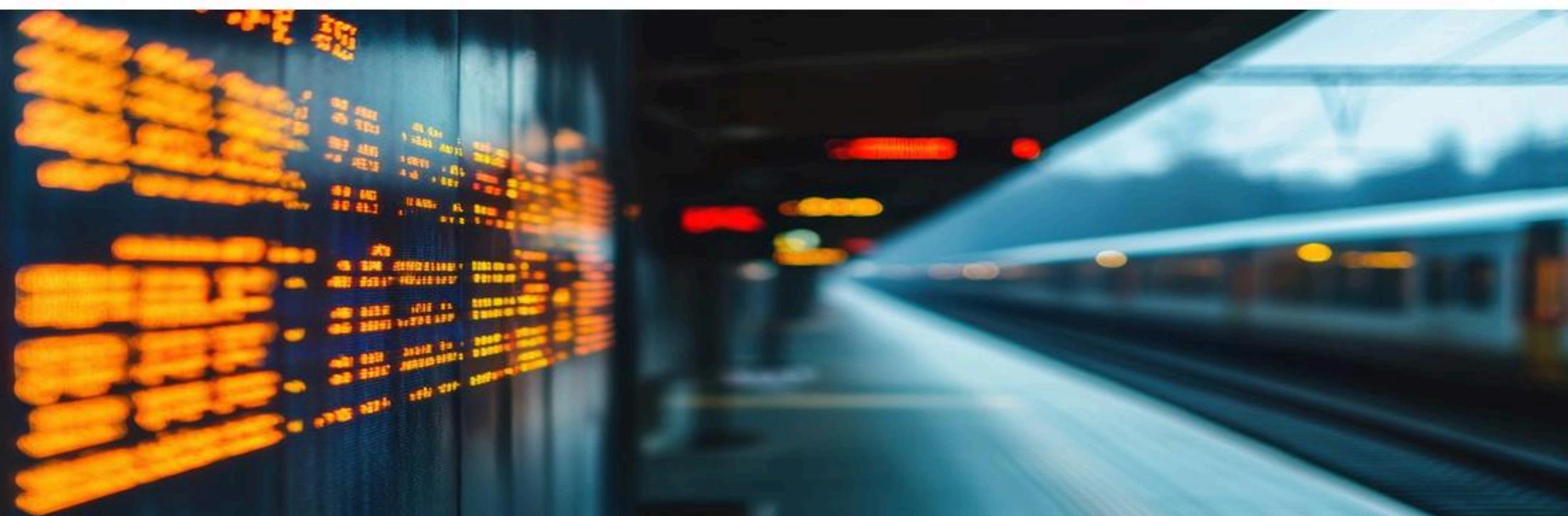
/ GROWING CYBERSECURITY RISKS

COMPREHENSIVE VIEW

TRACTION UNIT

1	4
2	5
3	4.1
4	4.2
5	50
6	
7	

ENCRYPTED

6

FIREWALL

S3 ENDPOINT

| 2.1 |
| 2.4 |
| 3.3 |
| 4.1 |
| 27 |
| 17 |
| 50 |

PENTESTED   CNAPP

aws   CLOUD CAF

S3 STORAGE

LEADMIND
ENDPOINT

1   6

| 1 |
| 3 |
| 4 |
| 5 |
| 7 |
| 8 |

| 1 |
| 2 |
| 5 |

WAF ENABLED

END USER

| 2 |
| 4 |
| 5 |
| 8 |

HTTPS (ENCRYPTED)
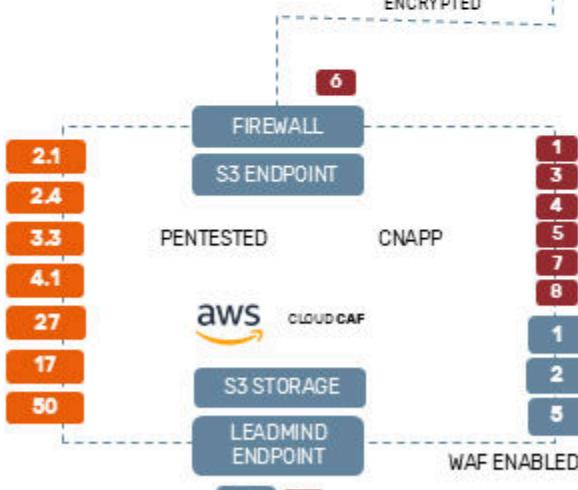
CNAPP: **C**loud **N**ative **A**pplication **P**rotection **P**latform

/ CYBER **GUIDELINES**

2.1	IEC 62443 – 2-1
2.4	IEC 62443 2-3
3.3	IEC 62443 3-3
4.1	IEC 62443 4-1
4.2	IEC 62443 4-2
27	ISO 27001 + 27002
17	ISO 27017
50	TS 50701

/ CYBER **RISKS**

1	Ransomware
2	Social Engineering / Phising
3	Unpatched and Misconfig
4	Credential Stuffing
5	Password Cracking Attacks
6	Man-in-the-Middle Attacks
7	Denial-of-Service Attacks
8	Drive-by Download Attacks
9	Supply chain attacks: vulnerabilities and hacks in suppliers' software
	Insider threats: espionage, sabotage and data leakage

/ CYBER **CERTIFICATIONS**

1	SSDLC
2	Ext. ISO 27001 with controls from (62443-2.1)
3	62443-4.1 SLT 2.
4	Management of vulnerabilities and incidents (under development)
5	62443 3.3. IDS – Security Gateway

CLOSING REMARKS

THE CLOUD AS A KEY ENABLER

> **TO ENSURE A SCALABLE AND AVAILABLE FLEET**

TECHNOLOGY AT THE SERVICE OF THE BUSINESS CHALLENGE

> **TO DRIVE OPERATIONAL EXCELLENCE**

DIGITAL TRANSFORMATION

> **A HIGHLY CROSS-FUNCTIONAL PROCESS FOCUS ON BUSINESS IMPACT**

cafmobility.com

CAF

TRUST
IN MOTION