Enterprise software solutions for mining

Lumada APM – Carbones de Cerrejon

Luis Campusano – Sales Specialist Enterprise Softwares

09/11/2021

Hitachi Energy

Agenda

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1. About Hitachi energy
2. Carbones del Cerrejón + Hitachi Energy
3. Mining challenges
4. Lumada Portfolio (APM + FSM)
5. Demonstration
6. Customer outcomes

Hitachi Business

HITACHI
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HITACHI

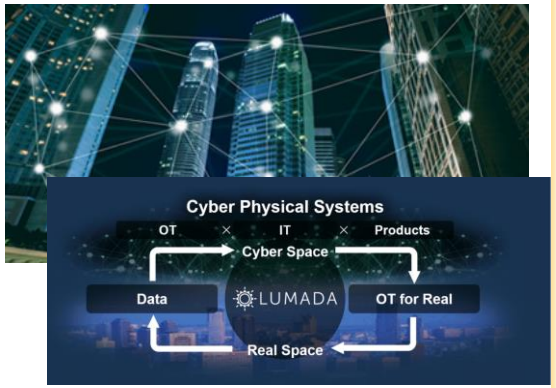
- Excavator and trucks
- Autonomous Haulage System

Wenco®

- Wencomine – FMS
- Ready Line – Asset health
- V2X – Collision avoidance
- Realtime Fatigue Alert

Hitachi Energy

- Lumada APM
- Ellipse EAM
- Lumana FSM
- Lumada EAM
- Substation automation, protection and control.
- Communication networks
- Transformers



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- **Hitachi Vantara**
- IoT Software and solution
- Storage and infrastructure
- Lumada Video Insights
- Infractrusture solution
- Lumada Video Analytics
- Drone

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Hitachi Energy

Grid Automation

Grid Integration

High Voltage products

Transformers

Automation & Communication

Grid Edge Solutions

Enterprise Software Solutions

- Enterprise Asset & Work Management
- Asset Performance Management
- Energy Portfolio Management
- Network Control

Segment
Mining
O&G
Industry
Renewables
Utilities

Commercial Relationship

Customer Since 1991

Hitachi Solutions:

Ellipse

Linkone

Axis

Signed a ~$1.2Musd maintenance agreement that covers 2020-2021, 2021-2022 and 2022-2023 period.

Next renewal date: Sep 2023.

Building Future Workshop Series:

IT Team

Supply & Material

Finance

Strong Relationship

Cerrejon 2022 – Outcome Workshops

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	3 a 9 Meses	9 a 18 Meses	Futuro
Digital mining	Fase 3		
Production optimization	Fase 2	Fase 4	
Upgrade strategic platform	Fase 1		

Integration Ellipse + Lumada FSM or APM.

Services

Ellipse Contract suscription (SaaS)

Renewal

NEW PROYECT LUMADA ECOSYSTEM

SOLUCIÓN

NEW PROYECT LUMADA ECOSYSTEM

SOLUCIÓN

Transition from Ellipe to Lumada EAM

SW Solution

APM Analytics + Wenco's asset health management (Trucks)

SERVICIO

Migration from Ellipe to Lumada EAM (Budgetary proposal)

SW Solution

PoC Lumada FSM GeoFence + Movility

SW Solution

Migration Ellipse from On Premise to SaaS

SW Solution

Workshop para Levantamiento de Requerimientos y Especificaciones

Services

Customization with GIDE (Enhance inventory Reports)- Ellipse

CSO-Custom

New Ellipse training for User

CSO-Consulting

Integration 3° Party SW with Ellipse (Coupa)

CSO Consulting

Customized Purchase Report in Ellipse

CSO-Custom

move a portal supplier to a direct EDI via CAT IP. (AXIS)

CSO-Custom

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Mining challenges

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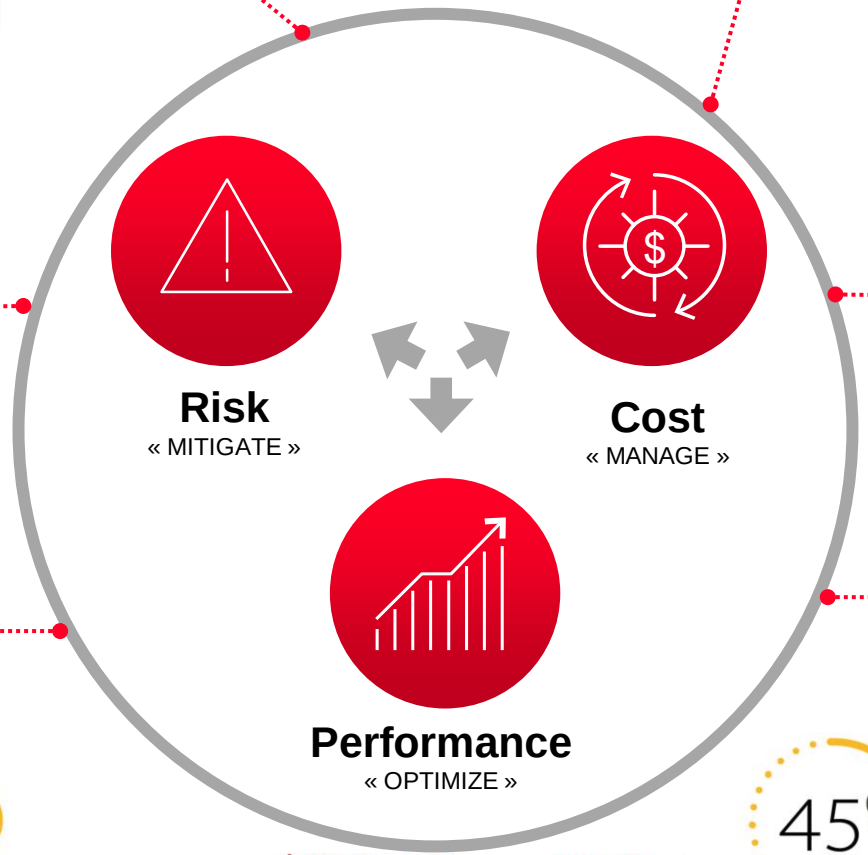
Business challenges around asset management

Mineral processing is becoming more demanding

Aging infrastructure
Maintaining and/or replacing existing infrastructure is a constant battle.

Reliability
Increasing pressure for continual reliability improvement and customer satisfaction.

Processing is more demanding
Processing is more demanding
To process ore to same value



Safety & transitioning workforce
The need to keep all workers safe and continually train new workers.

Spending justification
Revenue challenges and regulatory inspection will drive total expenditure focus and cost constraints.

Enhanced Operational Efficiency
Mining companies struggle to collect and aggregate data

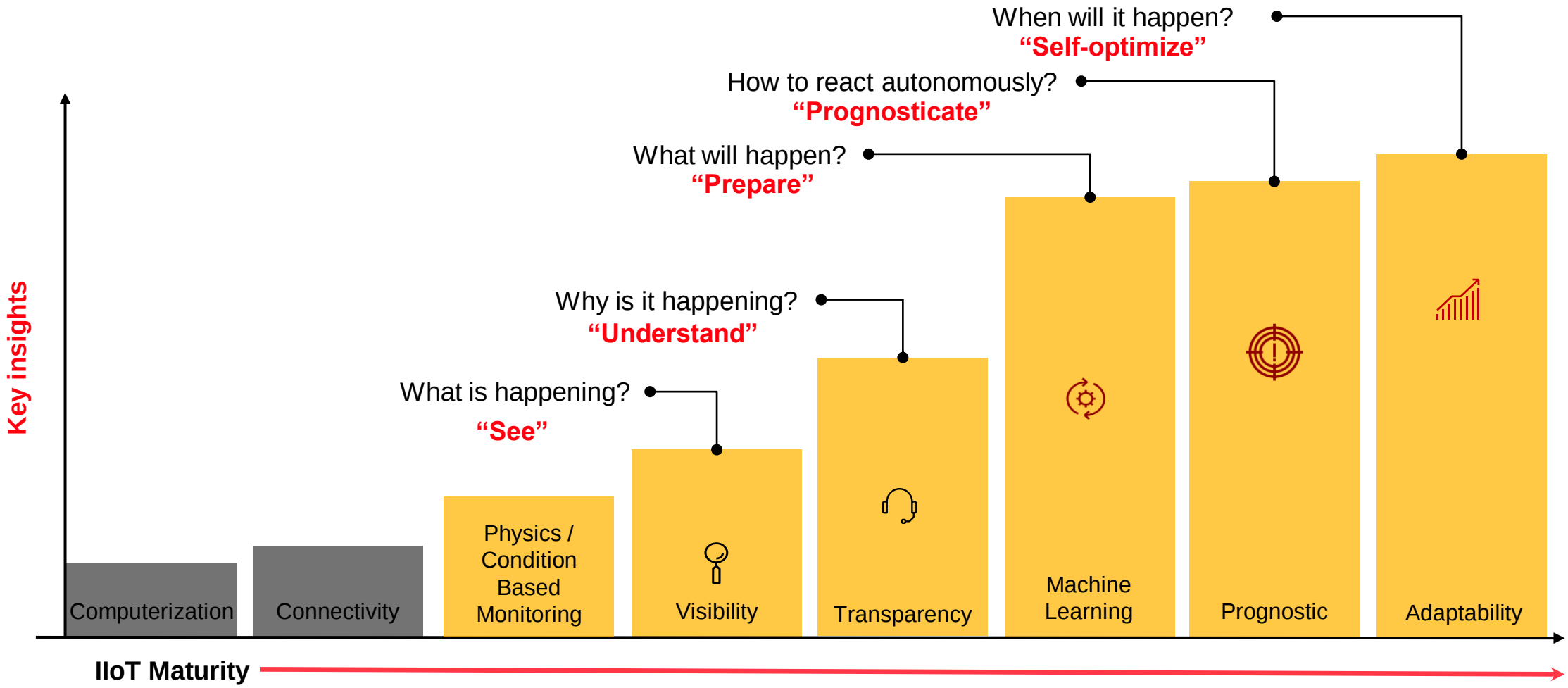
82%
of assets have a random **failure pattern,** and traditional preventive maintenance strategies are mostly ineffective in managing equipment downtime and maximizing lifetime.
Source: ARC Advisory Group

51% of companies have seen a measurable ROI using augmented reality for employee training and knowledge transfer.

45%
of executives report the inability to access data as a key barrier to solving their challenges.
Source: SCM World/Cisco

The power of data is stuck in silos.

Key insights for asset performance in Industry 4.0



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Lumada Platform

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Enterprice Software Porfolio: Lumada Ecosystem

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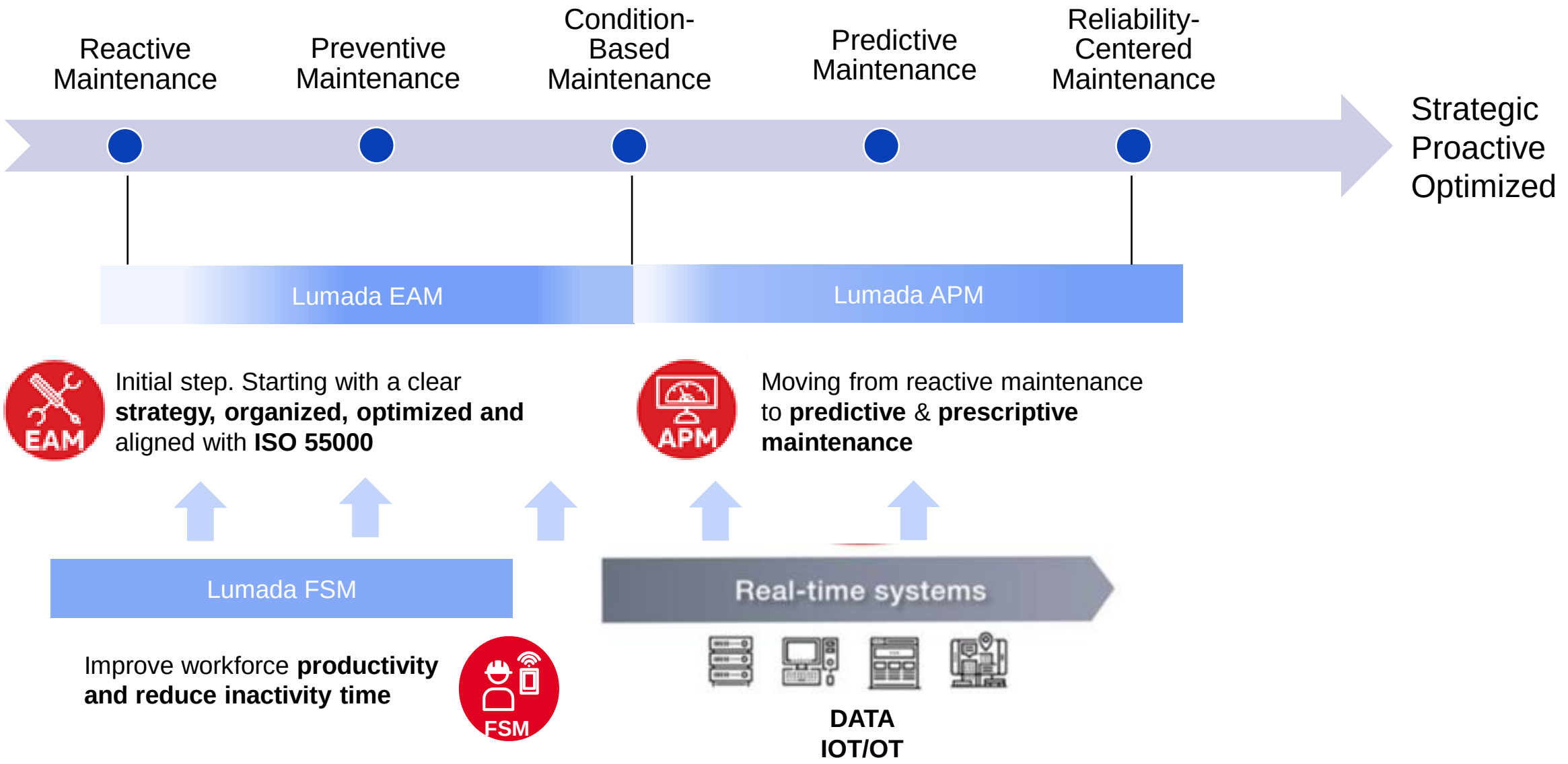

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Asset Performance Management – Lumada APM

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01.	**Failure mode analysis**	Identify and address potential failure modes driving future condition and risk on the asset
02.	**Retrospective analysis**	Improve future operational decision making through analysis of a re-constructed historical failure event
03.	**Prognostic condition forecast**	Optimize maintenance activities with early detection of approaching failures and quantitative risk information
04.	**Simulation**	Extend Remaining Useful Life of critical equipment

Hitachi Energy – Lumada APM

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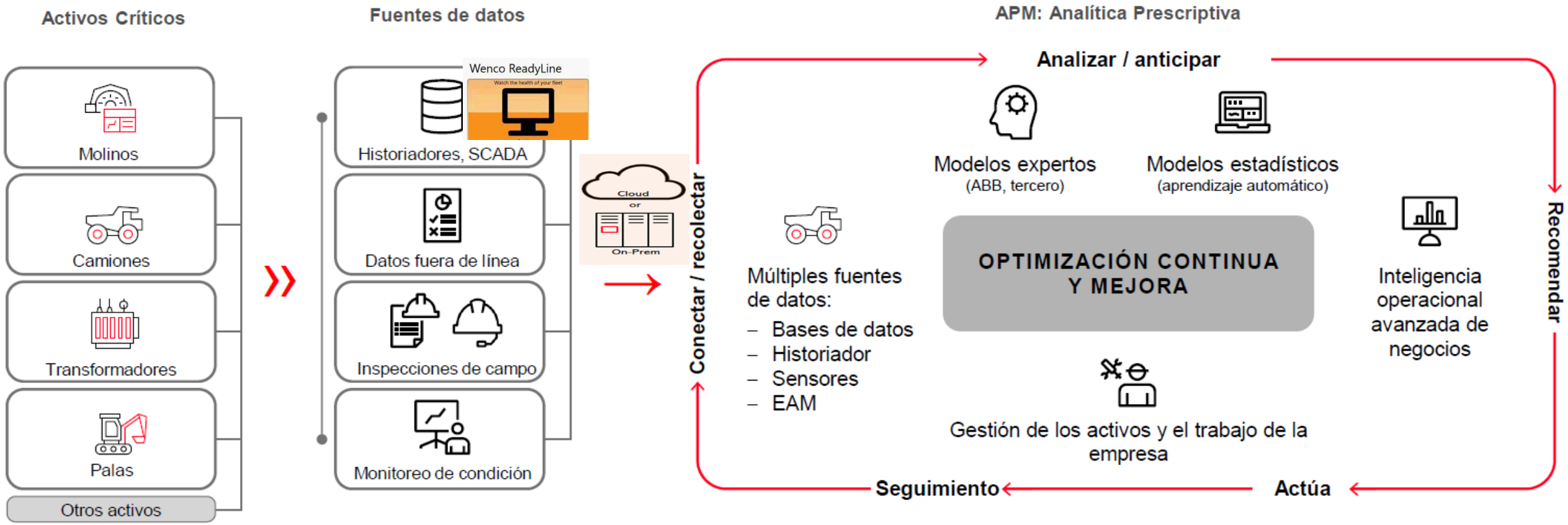
Mantenimiento Centrado en la Confiabilidad



Combinando datos de diferentes fuentes para obtener el máximo valor de sus activos

Lumada APM: Mantenimiento Centrado en la Confiabilidad

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Activos Críticos

- Activos eléctricos: transformadores, interruptores, líneas de transmisión, etc.
- Máquinas rotativos: motores, *fans* bombas, generador y turbinas.
- Activos de proceso: molinos, correas, camiones, palas, etc
- Modelos abiertos para otros activos

OPEX Optimizado

- Condición y Recomendación
- Prioridad de Mantenimiento
- Reducción de horas extras
- Reducción de costos en materiales
- Reducción de mano de obra de terceros

CAPEX Evitado

- Economías con reemplazos de activos críticos
- Extensión de vida útil de los activos
- Prioridad de reemplazo de activos

Mantenimiento reactivo

Mantenimiento basado en el tiempo o uso

Mantenimiento basado en la condición

Mantenimiento predictivo

Mantenimiento centrado en la confiabilidad

Predictivo, Prescriptivo, Pronóstico

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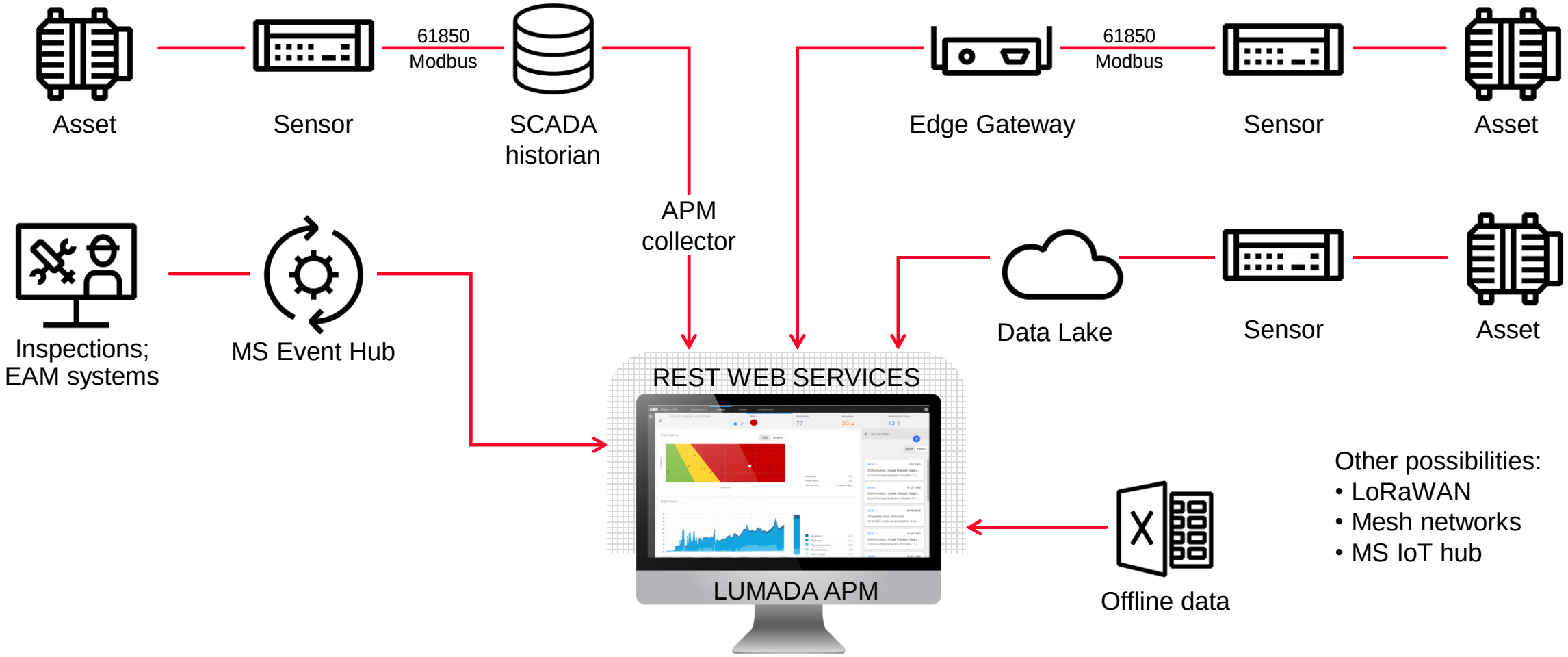
Lumada APM – Connect and Collect



Proof Of Concept (Ready Line + APM + Ellipse)

Work Order

Lumada APM (SaaS)

EAM

Wenco ReadyLine

Watch the health of your fleet

Off-line data

Work Order

IiOT Sensor/Computer

Field Inspection

Critical Asset

APM Performance Models

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Expert Models
Built based on the foundation of 70 plus years of experience in servicing equipment's

Advanced Physics based Algorithms
Years of domain knowledge gone into building these algorithms

Thousands of Expert Recommendations
Codified servicing expertise to recommendation

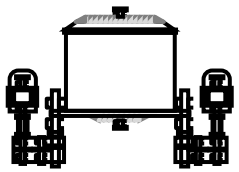
Advanced Mathematical Models
Stochastic process model (Markov), Stochastic inference model (Bayes)

Remaining Useful Life curve
For rotating equipment's like turbines, motors, pumps etc.

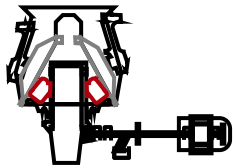
Critical Assets

Transformers

Circuit Breakers



SAG Mill



Crusher

Cyclone Pump

Motors

Electrical and Rotating Equipment's (200 plus)

- Steam Turbines
- Capacitor Banks
- Reactors
- Battery Banks

- Cables
- Motors
- Pulverizer
- Draft fan

- CCVT
- Surge Arrestors
- Proppant mixer
- Variable speed drive motor

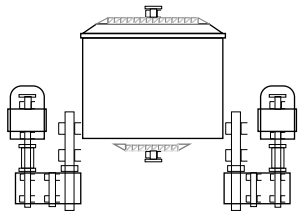
- Conveyors, feeders
- Cyclone pump
- Tertiary crusher

- Ball Mill
- Diesel engine
- Sag Mill

- Heat Exchangers
- Suction rolls
- Compressors
- Ventilator

Mining models overview

SAG Mill



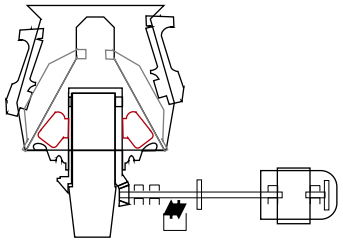
Measurements

- Temperature
- Lubricant
- Speed
- Pressure
- Flow
- Vibration
- Electrical Data

Malfunction Modes

- Coupling defects
- Dirty oil filter
- Drum lining unbalance
- Gear defect
- Gearbox bearing defect
- Insufficient oil supply
- Lubricant contamination liquids
- Lubricant contamination solids
- Lubricant degradation
- Mechanical looseness
- Motor rotor defect
- Motor stator defect
- Shaft misalignment
- Trunnion bearing defect
- Roller bearing defect
- Shaft bending

Crusher



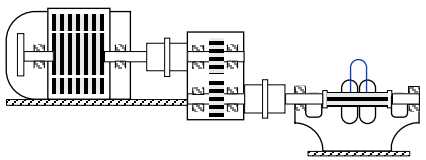
Measurements

- Temperature
- Lubricant
- Speed
- Vibration

Malfunction Modes

- Lubricant degradation
- Crusher shaft defect
- Structural looseness
- Motor stator problem
- Lubricant contamination liquids
- Lubricant contamination solids
- Crusher bearing fault
- Coupling defects
- Motor bearing defect
- Motor rotor defect
- Motor shaft latent defect

Cyclone Pump Set



Measurements

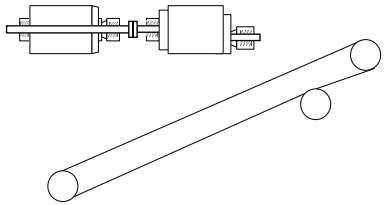
- Vibration
- Temperature
- Lubricant
- Flow
- Pressure
- Speed

Malfunction Modes

- Motor bearing defect
- Coupling defects
- Pump bearing fault
- Motor stator problem
- Lubricant contamination
- Lubricant degradation
- Gear defect
- Gearbox bearing defect
- Impeller defect
- Pump casing crack
- Pump seals defect
- Drive shaft defect
- Mechanical looseness

Mining models overview

Conveyor



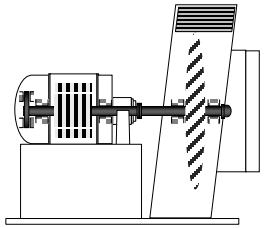
Measurements

- Electrical
- Vibration
- Lubricant
- Speed

Malfunction Modes

- Motor bearing failure
- Motor rotor/stator defect
- Coupling defects
- Gearbox bearing defect
- Gear defect
- Shaft defect
- Structural looseness
- Plummer block bearing defect
- Plummer block lack of lubrication
- Lubricant contamination solids
- Lubricant contamination liquids
- Lubricant degradation

Forced draft fan



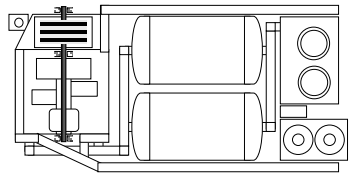
Measurements

- Temperature
- Lubricant
- Speed
- Vibration

Malfunction Modes

- Motor windings defect
- Axial bearing defect
- Radial bearing defect
- Control damper defect
- Fan rotor cracks
- Fan unbalance
- Coupling defect
- Fan vane crack
- Oil water contamination
- Oil particle contamination

Compressor



Measurements

- Vibration
- Pressure

Malfunction Modes

- Main pipe leaking
- Air dryer defect
- Pressure dew point false
- Noise and/or vibrations
- Bushings defective
- Loss of oil
- Oil level too low
- Oil tank overfilled
- Ageing

Lumada APM Prognostics for Haul Trucks – Hydraulic System

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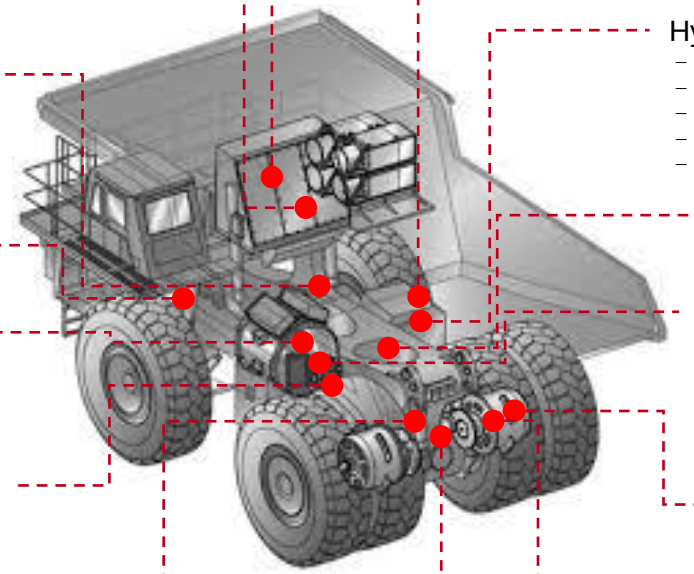
9 Temperature measurements
1 Lubrication Oil analysis
1 Electrical measurement
14 Pressure measurements
2 Speed Sensors

Malfunction Modes	Data Source
Failure to maintain required hydraulic oil flow and pressure	P1 P3 P4 P5 P6 P8 T1 Z1
Lubrication oil degradation for main hydraulic pump	P3 P4 P5 P6 T1 L1
Failure to travel	P7 P9 P10 P11 P12 P13 T2 T3 T4 T5 T6 T7 T8 T9 E1 Z2 Z3
Failure to steer	P7 P9 P10 P11 P12 P13 T2 T3 T4 T5 T6 T7 T8 T9 E1 Z2 Z3
Failure to brake	P7 P9 P10 P11 P12 P13 T2 T3 T4 T5 T6 T7 T8 T9 E1 Z2 Z3
Inability to operate the hauler bed (dump box) on demand	P10 P11 P13 P14 Z4 Z5

Stochastic process model (Markov)
Stochastic inference model (Bayes)

6 malfunction mode templates

60 Plus Raw and Calculated Parameters



Control Cabinet
- T6: Inverter temperature

Grid box
- T7: temperature
- E1: Resistor load

Hoist
- P13: Inline filter pressure
- P14: Hoist pressure
- Z4: Incline sensor
- Z5: Payload

Suspension cylinder (Front)
- P10: Pressure

Hydraulic boost pump
- P8: boost pump suction & discharge pressure

Gear pump (for rear brake cooling oil)
- P12: Gear pump discharge pressure

Suspension cylinder (Rear)
- P11: Pressure

Rear brake cooling tank
- Z2: Oil level
- T3: Oil temperature

Hydraulic oil tank
- Z1: Oil tank level
- P1: Oil tank pressure
- T1: Oil temperature
- P6: Return oil filter pressure
- L1: Oil analysis

Wheel motor blower
- T4: temperature

Main hydraulic pump 1 & 2
- P3: Main pump 1 suction & discharge pressure
- P4: Main pump 2 suction & discharge pressure
- P5: Suction oil filter pressure

AC wheel motor
- T2: Motor temperature
- T9: Bearing temperauter

Wheel reduction gear device
- Z3: Oil level
- P9: Oil filter pressure

Gear pump
- T5: gear oil discharge temperature
- P7: gear pump discharge pressure

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Lumada APM Prognostics for Haul Trucks – Electrical System

HITACHI
Inspire the Next

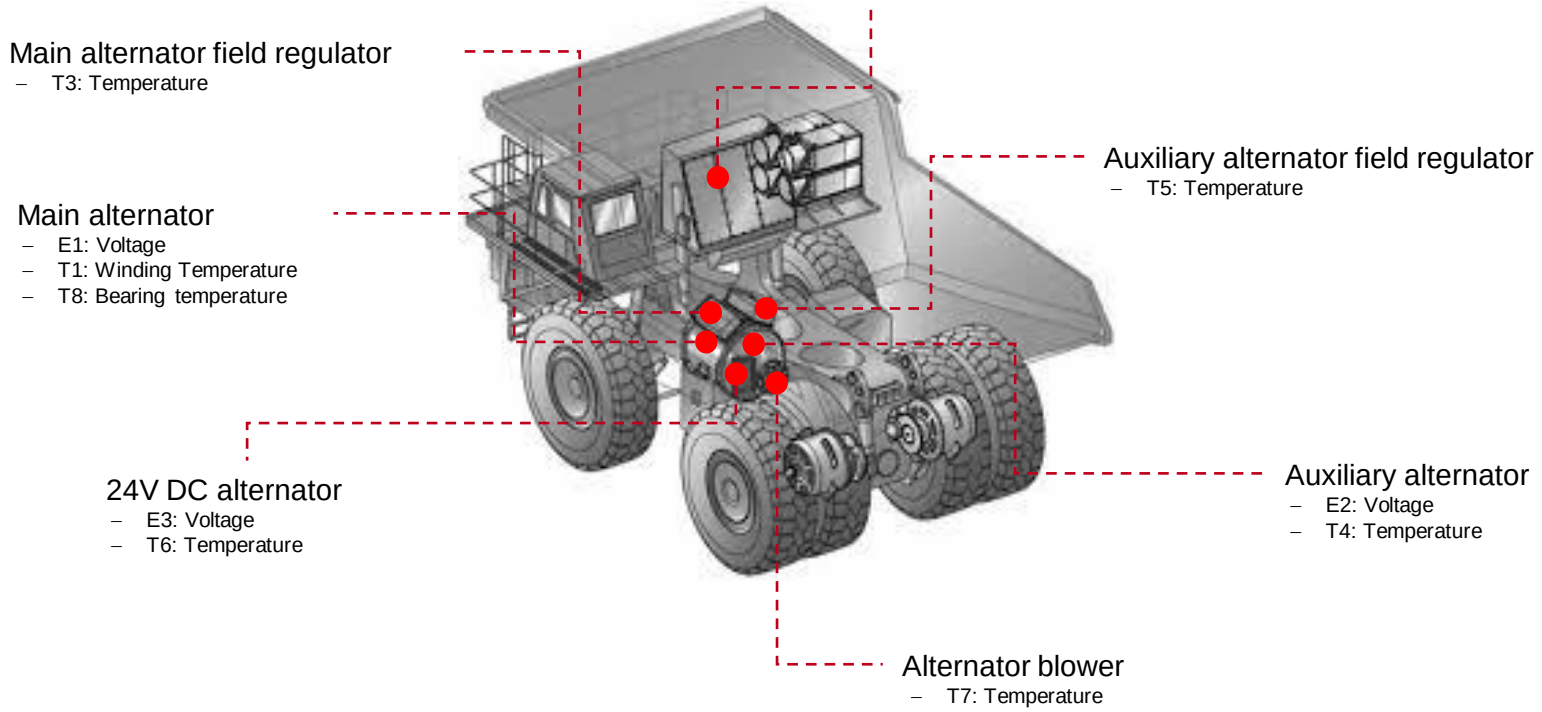
8 Temperature measurements
4 Electrical measurements
1 Speed sensor

Stochastic process model (Markov)
Stochastic inference model (Bayes)

3 malfunction mode templates

10 Plus Raw and Calculated Parameters

Malfunction Modes	Data Source
Failure of the main alternator system	E1 E2 E4 T1 T2 T3 T4 T5 T8
Failure of the auxiliary alternator system	E1 E2 T2 T3 T4 T5
Failure of the 24V DC alternator system	E3 T6 T7



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Lumada APM Prognostics for Haul trucks – Diesel engine

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Inspire the Next

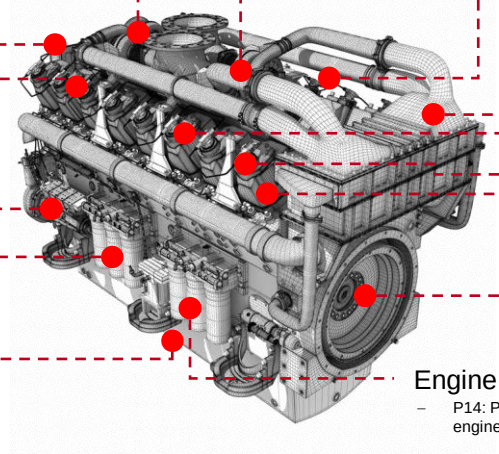
7 Temperature measurements
1 Lubrication oil analysis
14 Pressure measurement
3 Speed Sensors
2 Flow measurements

Malfunction Modes	Data Source
Failure to provide sufficient volume and quality of intake air	P1 P2 P3 P7 F1 T1 T3 T5 R1 R2 V3 Z1 X1 Z5 R3
Failure to provide required power and RPM	P1 P2 P3 P4 P6 P7 P10 F1 T1 T3 T5 T6 R1 R2 Z1 Z3 Z5 X1
Failure to provide sufficient exhaust gas capacity	P1 P6 R1 R2 V3 Z5 G1
Failure to provide required cooling water flow, pressure and temperature	P3 P7 P10 T1 T2 T3 T4 T5 R3 Z2 Z5 W1
Failure to provide required fuel oil quality, flow and pressure	P2 P9 P10 P11 P12 F2 T6 Z1 Z3 Z5 D1
Failure to provide required lubricating oil flow, pressure, and quality	P13 P14 T7 R2 Z4 L1

Stochastic process model (Markov)
Stochastic inference model (Bayes)

6 malfunction mode templates

90 Plus Raw and Calculated Parameters



Turbocharger
- P3: Boost pressure
- R1: turbocharger speed

Exhaust pipe
- T2: exhaust pipe temp
- P6: exhaust manifold pressure
- G1: exhaust gas composition

Coolant filter
- P8: Pressure across filter

Aftercooler
- T4: Coolant outlet temp
- T5: Air outlet temp

Fuel rail
- P10: Fuel rail pressure

Intake manifold
- P2: intake manifold pressure
- T1: intake manifold temp.

Engine fuel pump
- P9: Suction/Discharge pressure
- F2: Fuel flow rate
- T6: Fuel temperature

Cylinder valve
- V3: cylinder valve vibration

Exhaust valve
- T3: cylinder exhaust temp

Fuel filter
- P11: Pressure across filter

Cylinder
- P5: cylinder pressure.

Engine shaft
- R2: Shaft speed
- Z5: Engine torque

Engine (lube) oil sump
- Z4: Engine oil level
- L1: Lube oil analysis

Engine oil filter
- P14: Pressure across engine oil filter

Elements considers in the model but not shown in the diagram

Engine fuel tank
- Z3: Tank level
- D1: Fuel oil analysis

Crankcase
- P4: crankcase pressure

Surge tank
- Z2: Coolant level
- W1: Coolant chem. analysis

Fan
- R3: Fan speed

Accelerator pedal
- Z1: Accelerator pedal position

Fuel strainer
- P12: Pressure across fuel strainer

Engine oil pump
- P13: Engine oil pressure
- T7: Engine oil temp.

Air filter
- P1: Pressure across air filter
- F1: Air flow

Radiator
- P7: Coolant pressure
- T3: Coolant temp.

External
- X1: ambient temp.
- X1: relative humidity

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Lumada APM Prognostics for Excavators – Hydraulic System

HITACHI
Inspire the Next

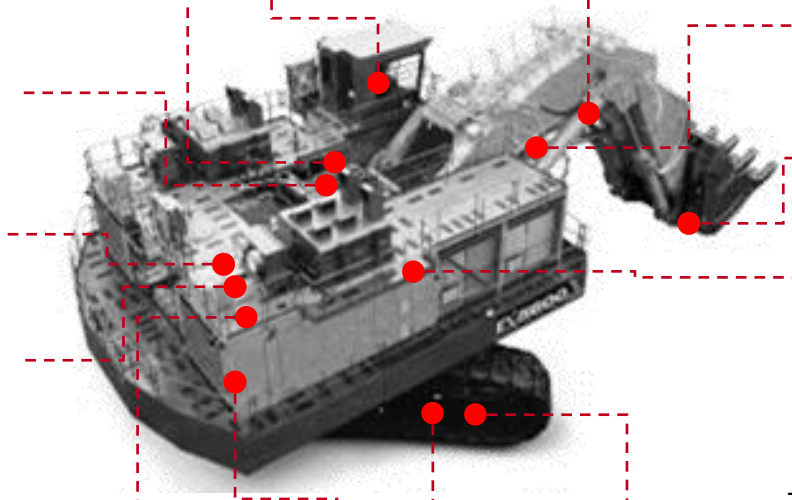
7 Temperature measurements
1 Lubrication Oil analysis
17 Pressure measurements
1 Speed Sensors

Stochastic process model (Markov)
Stochastic inference model (Bayes)

4 malfunction mode templates

70 Plus Raw and Calculated Parameters

Malfunction Modes	Data Source
Failure to Maintain Required Hydraulic Oil Flow, Pressure and Temperature	P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 T1 T2 T3 T4 Z1 Z2
Failure to Maintain Required Hydraulic Oil Quality	P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 T1 T2 L1
Failure to Travel, Steer or Brake on Demand	P14 T3 T4 T5
Inability to Operate the Shovel or Bucket / Backhoe on Demand	P15 P16 P17 T6 T7 Z5



Cabine
- Z3: Travel pedal position
- Z4: Steering pedal position
- Z6: Swing lever position

Swing reduction gear
- T6: Reduction gear temp
- Z5: Reduction gear oil level

Swing motors
- T7: Hydraulic motor temp

Pilot pumps (2 of them)
- T4: Temperature

Pump transmission
- Z2: Transmission oil level
- T2: Transmission oil temperature
- P10: Pressure transmission oil circuilation pump

Main hydraulic pumps (8 of them)
- P2 – P9 : Pressure Main Pump 1-8

Pump transmission oil filter
- P11: Pressure

Shovel arm cylinder
- P15: Cylinder pressure (left & right)

Boom cylinder
- P16: Cylinder pressure

Shovel dump cylinder
- P17: Cylinder pressure (left & right)

Hydraulic tank
- Z1: Oil level
- P1: Oil pressure
- T1: Oil temperature
- P12: Suction filter pressure
- P13: Full-flow filter pressure
- L1: Lube oil analysis

Travel reduction gear
- T3: Temperature

Hydraulic travel motor (2 motors left and right)
- T5: Temperature

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Lumada APM Prognostics for Excavators – Diesel engine

HITACHI
Inspire the Next

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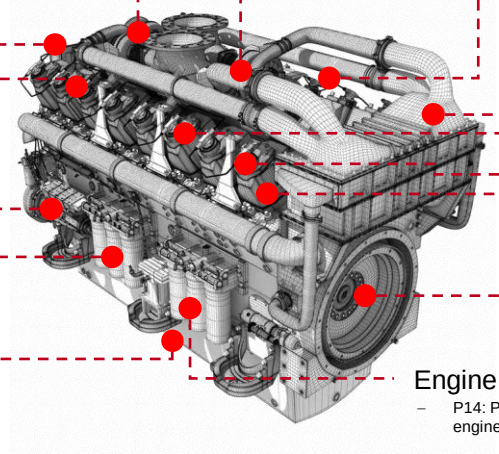
Failure to provide required cooling water flow, pressure and temperature	P3 P7 P10 T1 T2 T3 T4 T5 R3 Z2 Z5 W1
Failure to provide required fuel oil quality, flow and pressure	P2 P9 P10 P11 P12 F2 T6 Z1 Z3 Z5 D1
Failure to provide required lubricating oil flow, pressure, and quality	P13 P14 T7 R2 Z4 L1
Failure to provide electrical power to support asset functions	T8 T9 E1 E2

Stochastic process model (Markov)
Stochastic inference model (Bayes)

7 malfunction mode templates

90 Plus Raw and Calculated Parameters



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Engine oil filter
- P14: Pressure across engine oil filter

Elements considers in the model but not shown in the diagram

Engine fuel tank
- Z3: Tank level
- D1: Fuel oil analysis

Crankcase
- P4: crankcase pressure

Fan
- R3: Fan speed

Surge tank
- Z2: Coolant level
- W1: Coolant chem. analysis

Rectifier
- E2: Recifier Voltage

Accelerator pedal
- Z1: Accelerator pedal position

Fuel strainer
- P12: Pressure across fuel strainer

Engine oil pump
- P13: Engine oil pressure
- T7: Engine oil temp.

Air filter
- P1: Pressure across air filter
- F1: Air flow

Radiator
- P7: Coolant pressure
- T3: Coolant temp.

Alternator
- T8: Winding temp
- T9: Bearing temp
- E1: Alternator voltage

External
- X1: ambient temp.
- X1: relative humidity

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Benefits of Lumada APM for Mining

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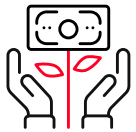
One source of IT/OT truth means better decision-making and improved execution

Business is driving the push towards digitalization with the reward of improved operations, lower costs and increased agility. Digitalization will help:

Balance high asset utilization and load with sufficient uptime

Upgrade from time-based to forecast-based maintenance



Optimize O&M costs

Adjust asset management efforts to align with commercial opportunities

Quickly establish an asset performance management solution that grows with you

Prioritize mission critical assets according to future risk profile

Customer Experiences – Hitachi Energy + Vantara

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Bengalla Mining Company finds Big Productivity Gains in Incremental Improvements with Lumada

Learn how Bengalla Mines deliver real-time insights to mine technicians to gain control, reduce variance and optimize productivity.

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Demonstration

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Support for a wide variety of mining assets

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Examples:

Machinery

Cyclone Pump Sets

SAG Mill & Ball Mill

Main & Pebble Crushers

Conveyors & Feeders

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Right information, right now

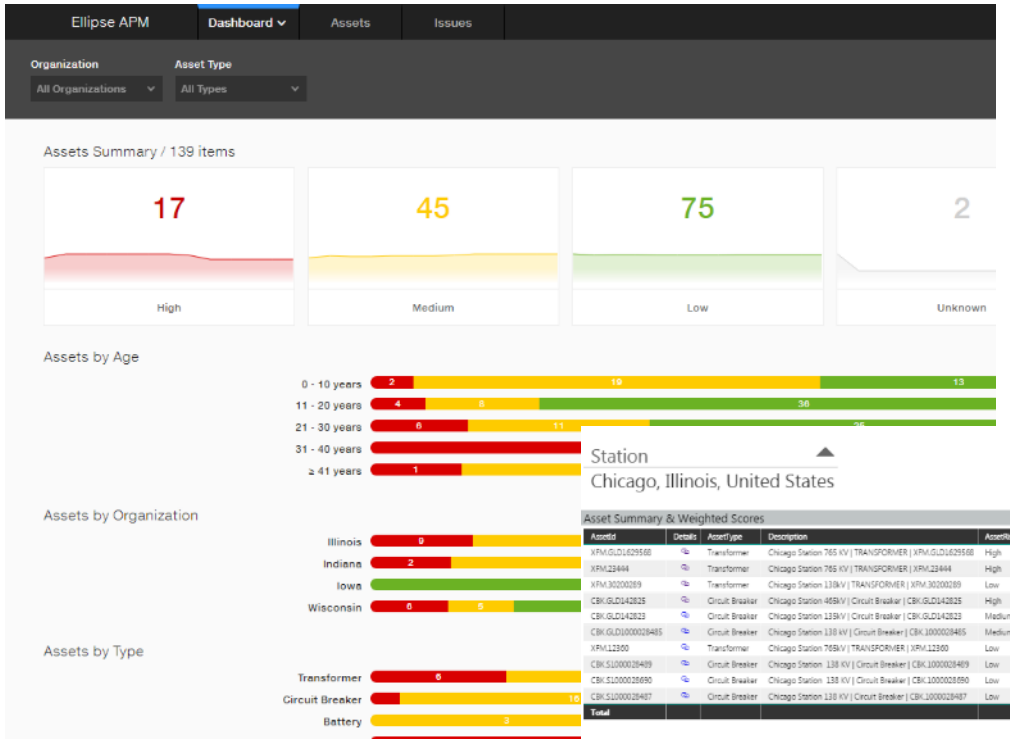
Fleet analysis

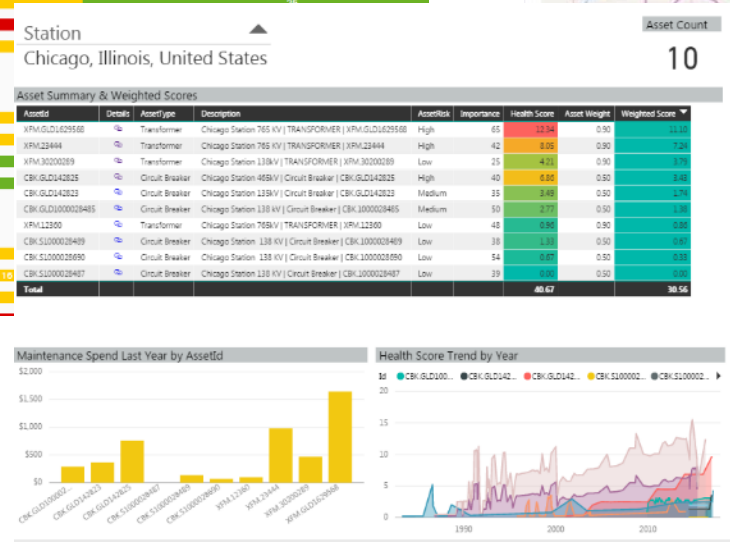
Fleet health

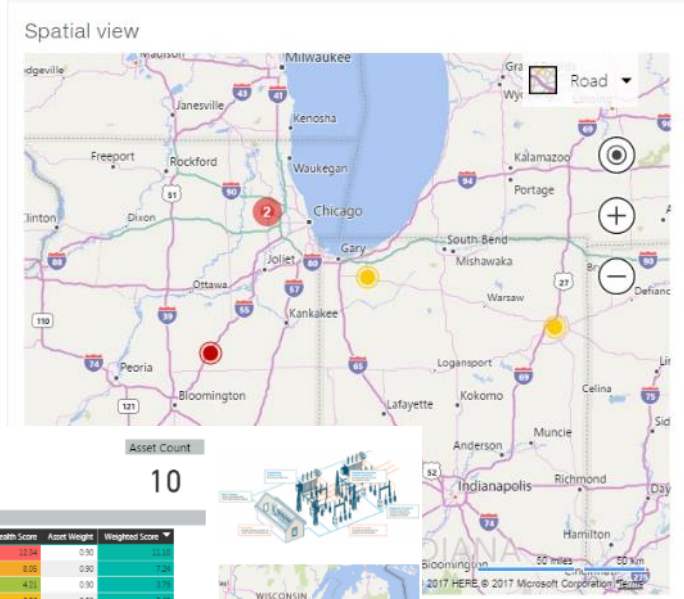
Assess fleet health by:

- Region
- Process
- Asset type
- Age

The most important issues are front and center.







Right information, right now

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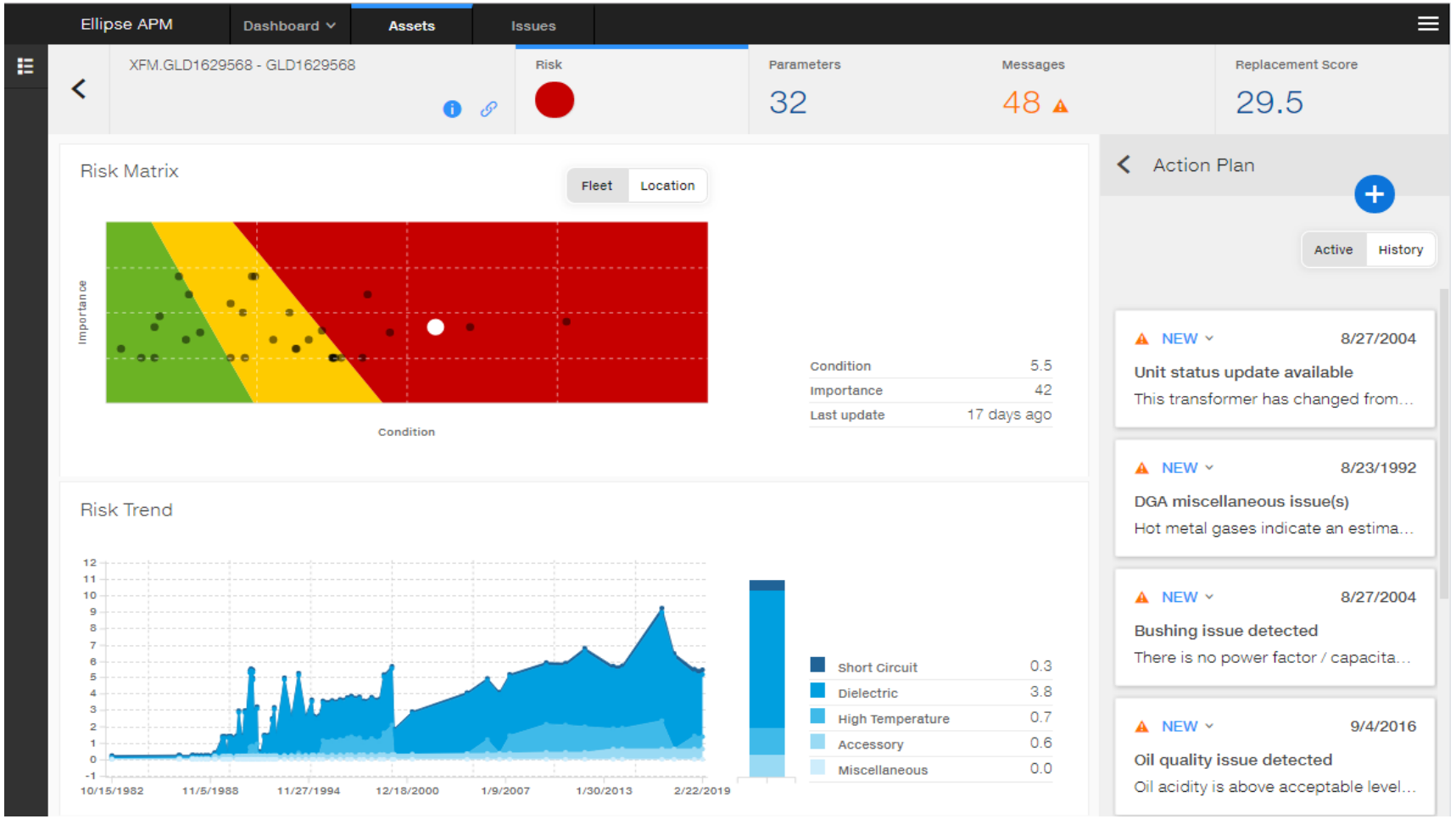
Asset analysis

Asset details and analysis tools

Assess fleet health by:

- Asset health history
- Analyze by sub component
- Issues automatically generated
- Send work requests to EAM
- Data trending and analysis
- Compare to family
- Duval triangles and other industry standard analysis tools

Analyze details, check before you roll



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Right information, right now

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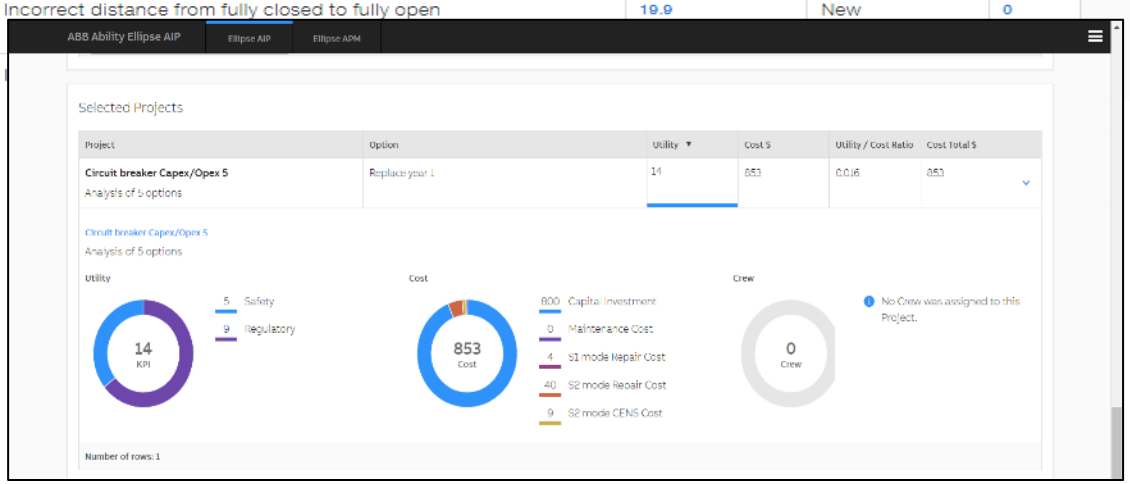
Maintain and replace analysis

Prioritize maintenance and replacement

- Prioritize and track maintenance issues
- Assets are flagged for replacement
- Choose existing replacement algorithm or create your own

Plan for today and the future

Asset	Condition	Risk	Issue	Maintenance Priority	Status	Actions
CBK.990 - B88790 Valparaiso, Indiana / Circuit Breaker	47.6		The Breaker failure during a Close-Open operation	11.9	Monitor	0
CBK.990 - B88790 Valparaiso, Indiana / Circuit Breaker	47.6		Make sure that the joints tested are supposed to be included	11.9	Monitor	0
XFM.23444 - GD778899 Pontiac, Illinois / Transformer	6.0		DGA miscellaneous issue(s)	4.6	In Progress	0
CBK.GLD142825 - GLD142825 Chicago, Illinois / Circuit Breaker	49.6		The breaker failure during a Close-Open operation	19.9	New	0
CBK.GLD142825 - GLD142825 Chicago, Illinois / Circuit Breaker	49.6		Improper close operation	19.9	New	0
CBK.GLD142825 - GLD142825 Chicago, Illinois / Circuit Breaker	49.6		Invalid trip operation	19.9	New	0
CBK.GLD142825 - GLD142825 Chicago, Illinois / Circuit Breaker	49.6		Incorrect distance from fully closed to fully open	19.9	New	0
CBK.GLD142825 - GLD142825 Chicago, Illinois / Circuit Breaker	49.6					



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Proven solution, proven returns

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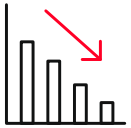
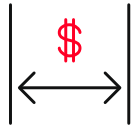
Actual customer savings and operational improvements



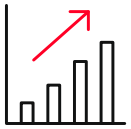
$14.8M reduction in catastrophic events (avoided asset failure)[3]

$1.2M reduction in unplanned outages[2]

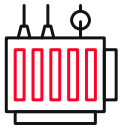
$2.0M reduction in planned outage costs[2]



Capex & working capital optimization – **$1.6M**



Recuperated costs equaling almost **2x** initial investment[1]



15% improvement in asset availability[2]

20% improvement in labor productivity[2]

10% reduction in asset running costs[2]

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Lumada Field Service Management (FSM)

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Enterprise-wide mobile workforce management

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Enabling digital transformation

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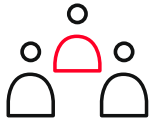
Productivity and efficiency gains across the entire organization – field to boardroom

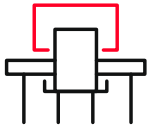


Field Crew

- Real time updates & interaction to/from HQ
- Less time spent on the road with more efficient routing

Maintenance & Repair

- Better outage planning
- Faster response time
- Eliminate paper-based reports
- Increased worker safety



Operations

- Live visibility of M&R work
- Faster trouble-shooting and workforce dispatch
- Better operational decision making

Compliance

- Accurate records for audits
- Avoid regulatory fines

Information Technology

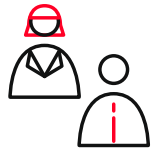
- Reduced IT footprint
- Lower maintenance overhead with cloud-based solution

Procurement

- Live visibility of inventory
- More accurate inventory forecasting and planning
- More efficient vendor management

Finance & Accounting

- Accurate records for cost accounting
- Financial models for budgeting and forecasting



C-Suite

- Single source of truth
- Better business intel
- Standardized business and operating processes
- Greater ROI on assets
- Preserve organizational knowledge

Lumada FSM

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What is Lumada FSM ?

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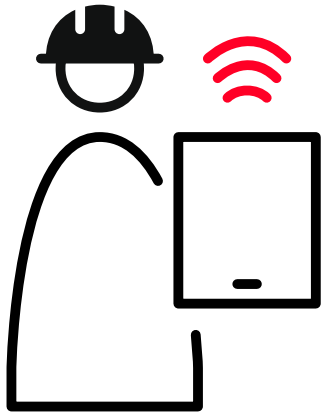
SaaS/cloud-based mobile extension to enterprise host systems

- Key component of the Lumada ecosystem
- Strategic part of Hitachi Energy digitalization initiatives
- Cloud-based mobile field service management solution
  - Fully integrated into Microsoft Azure cloud
  - **Today:** Solution designed to solve key operational challenges with assigning/dispatching and executing work
  - **Future:** Enterprise-wide workforce management. Addition of key modules/applications to support:
    - All work types
    - All technician groups
    - All host systems



Lumada FSM functional overview

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SaaS/cloud-based mobile extension to enterprise host systems

Back office systems

- CIS (customer billing)
- EAM (asset mgmt)
- OMS (outage mgmt)
- GIS (asset mapping)
- CRM/ERP (timesheets)

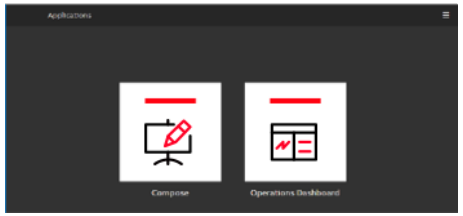
Work types

- Inspections
- Maintenance
- Meter/service
- Trouble
- Outages

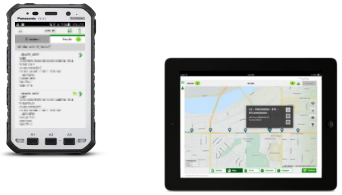
Lumada FSM components

Dispatch/supervise

Configure and manage



Field mobility



Microsoft Azure

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Benefits of Lumada FSM

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Adding value from the field to the back office

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Maintenance and inspection in asset-intensive industries

Field/mobile users

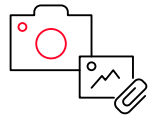
Bar code scanning

Geotagging/ GPS capture

Turn-by-turn directions

Signature capture

Wearable technology



Pictures & attachments

Managers/ office users

Supervisor application

Dispatch application

Partial work/ status updates

Configurable workflows

Integrated UX scripting

Administrative tools

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Available on all major mobile platforms

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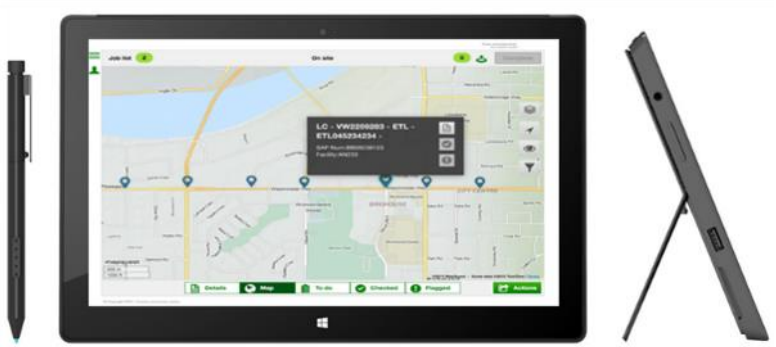
Simple: Common UX, easy to use **Productive:** Work anywhere, **on- or offline** **Flexible:** Laptops, phones or tablets



iOS

Windows 10

android

Download on the App Store

GET IT ON Google Play

Get it on Windows 10

Wearable device integration: Lumada FSM Hands-Free Inspector

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Keep your hands free even in dangerous situations, using only voice navigation and head gestures.
Paired with the field tech's mobile device and Lumada FSM application as a "companion"

realwear

Improved worker safety

- Keep safety gloves and hardhat on, reducing risk of injury
- Remain fully aware of environment vs. solutions that impair vision

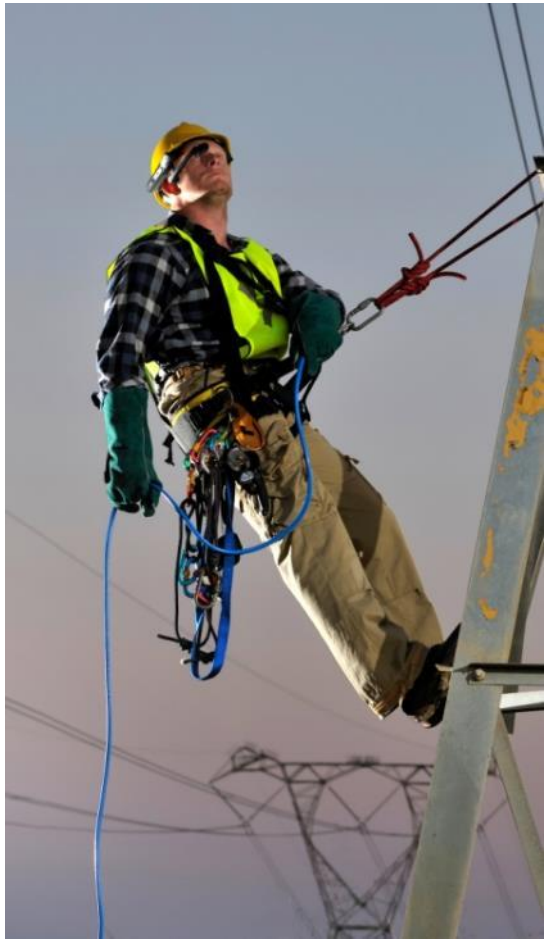
Better productivity

- All required information accessible on headset
- Eliminate time lost referring to paper documents

Easy to use

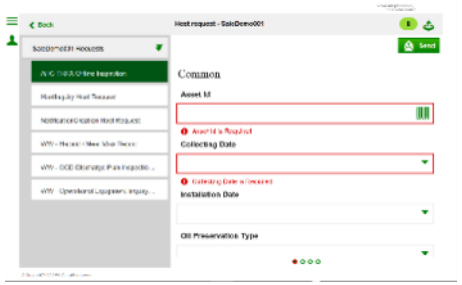
- Easily pairs with Lumada FSM for inspections and work order information

Wearable use cases

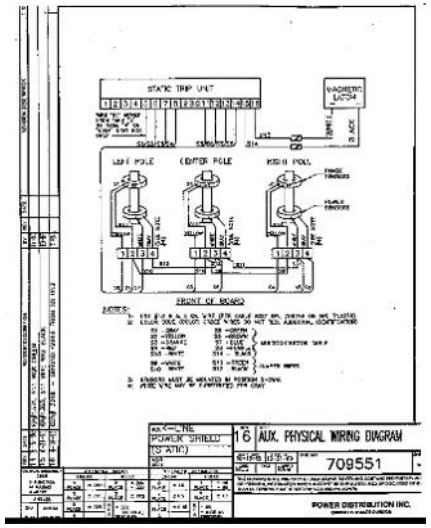


Remote mentoring/collaboration

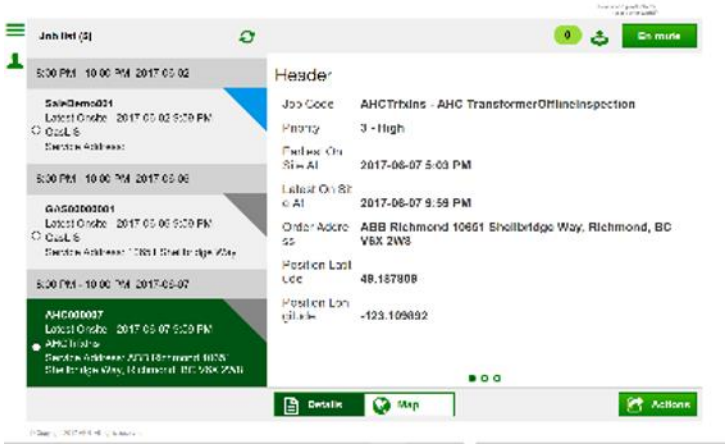
Form completion



View schematics



View order details



Chatbot order creation

Assignment, dispatch and monitoring

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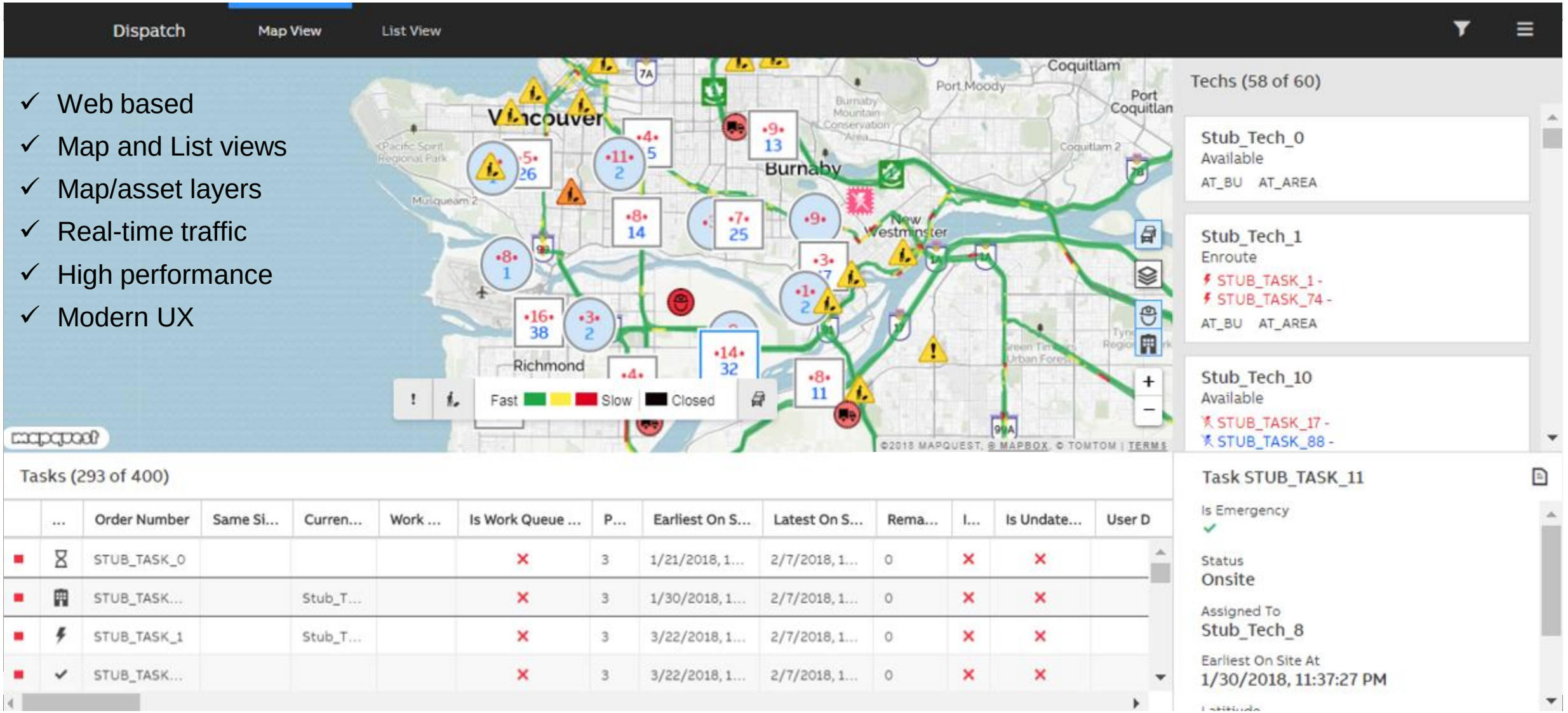
- ✓ Web based
- ✓ Map and List views
- ✓ Map/asset layers
- ✓ Real-time traffic
- ✓ High performance
- ✓ Modern UX



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Value across your operations

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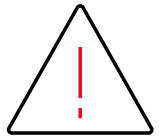
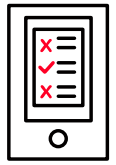


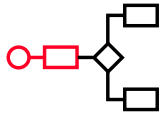
Improve HSE & safety goals

- Real-time integrated communications
- Emergency notifications
- Work “hands free”
- Back office visibility of field techs/staff
- Audit trail of all field transactions
- Data for analysis and process improvements



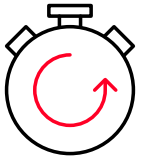
Digitalize all field work

- From simple work orders to both routine or complex inspections and maintenance
- Manage dynamic workflows digitally
- Eliminates manual work and paper processes



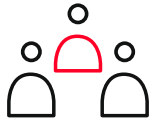
Standardize workflows

- Ensure compliance with inspection procedures
- Validation rules to improve data capture consistency and accuracy / quality



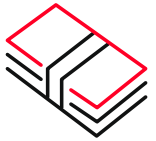
Productivity and efficiency

- Avg. productivity increase: 10%-30%
- Complete inspections faster
- Collaborate easier
- Minimize rework
- Improve data capture/accuracy



Improve field ops management

- See where field technicians are and what they are working on using map based assignment and dispatch with GPS tracking



Cost savings

- Lightweight; no costly upgrades – features delivered via cloud
- Apps simplify provisioning costs
- Std. integrations reduce risk
- Cloud shortens time from purchase to implementation

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Customer outcomes

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APM deployments and projects

Asset Performance Management – Business Outcomes & ROI

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Quantified business outcomes

- At least 5 Outotec SAG mill and Ball mill failures were prevented resulting in savings of over USD100K each with at least 70% likelihood of failure
- Reduction of annual costs of USD1M per asset at a mining facility
- With accurate forecast of several days, downtime costs for each motor or gear box failure event is reduced

ROI Calculation

- $1.2M reduction in unplanned outages[2]
- $2.0M reduction in planned outage costs[2]
- 20% improvement in labor productivity[2]
- 15% improvement in asset availability[2]
- 10% reduction in asset running costs[2]
- $14.8M reduction in catastrophic events (avoided asset failure)[3]
- Recuperated costs equaling almost 2x initial investment[1]
- Capex & working capital optimization – $1.6M

Customer example: condition-based malfunction forecasts for mining operations

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Asset scope

- Phase I: main crusher, two cyclone pumps and semi-autogenous grinding (SAG) mill
- Phase 2: ball mill, pebble crushers, feeders and conveyors

Business drivers

- Facing increased cost pressure
- Minimize maintenance costs and effort
- Ensure equipment reliability and availability
- Need actionable insights for operational decision making

Why APM?

- Forecast equipment condition, malfunction risks and maintenance needs
- Prognostic dashboard provides visual summary for quick decision making
- Easily integrate prognostics reports with EAM or FSM solutions

Value realized

- Successfully avoided a critical equipment malfunction with an estimated cost of US$220,000 and 12 hours of downtime
- Significantly reduced downtime costs by avoiding lost production from unscheduled delays
- Significantly reduced maintenance costs by better preparing for maintenance and replacement tasks
- Established a more robust and transparent decision process by effectively leveraging asset data collected

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