Assets Integrated Monitoring & Centralized Analytics System

Energy & Digital World

2024-10-30

Hitachi Energy

Agenda

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1. Assets Lifecycle
2. Managing Asset Performance
3. Lumada APM for Risk Based Maintenance
4. Use Case and Value
5. Q & A

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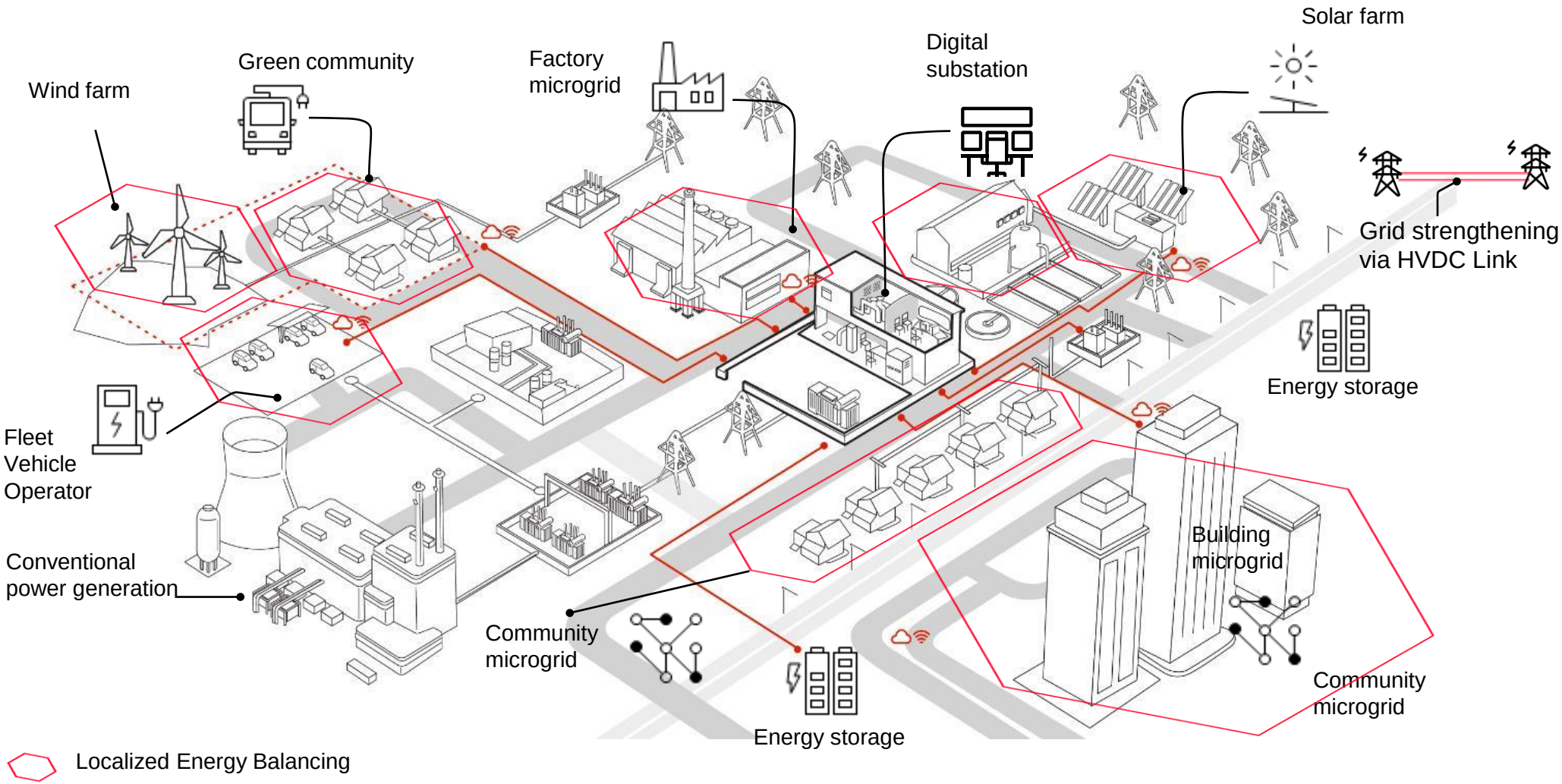
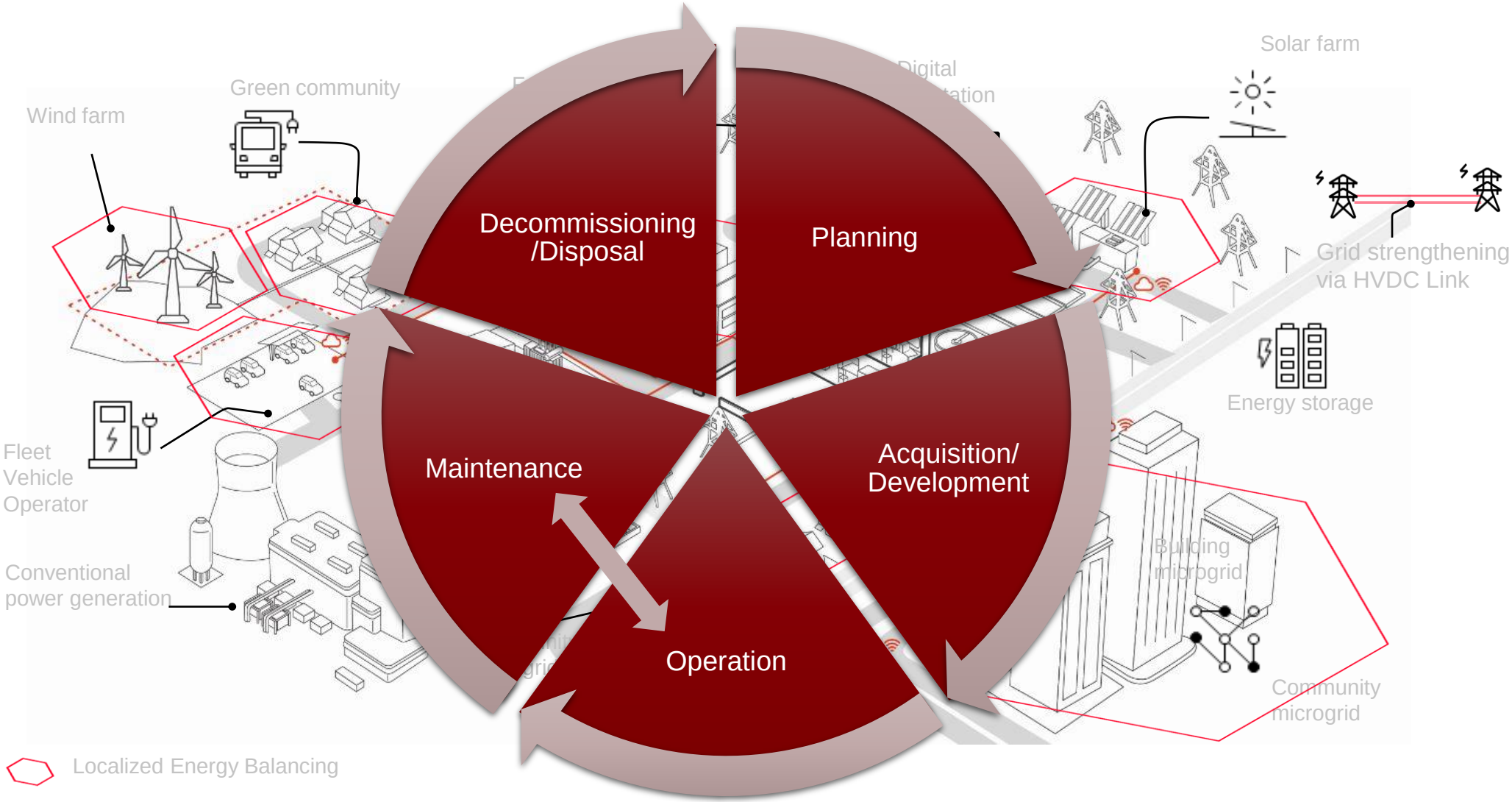
Power Generation to End Customer



Asset Lifecycle



Key indicators for asset management

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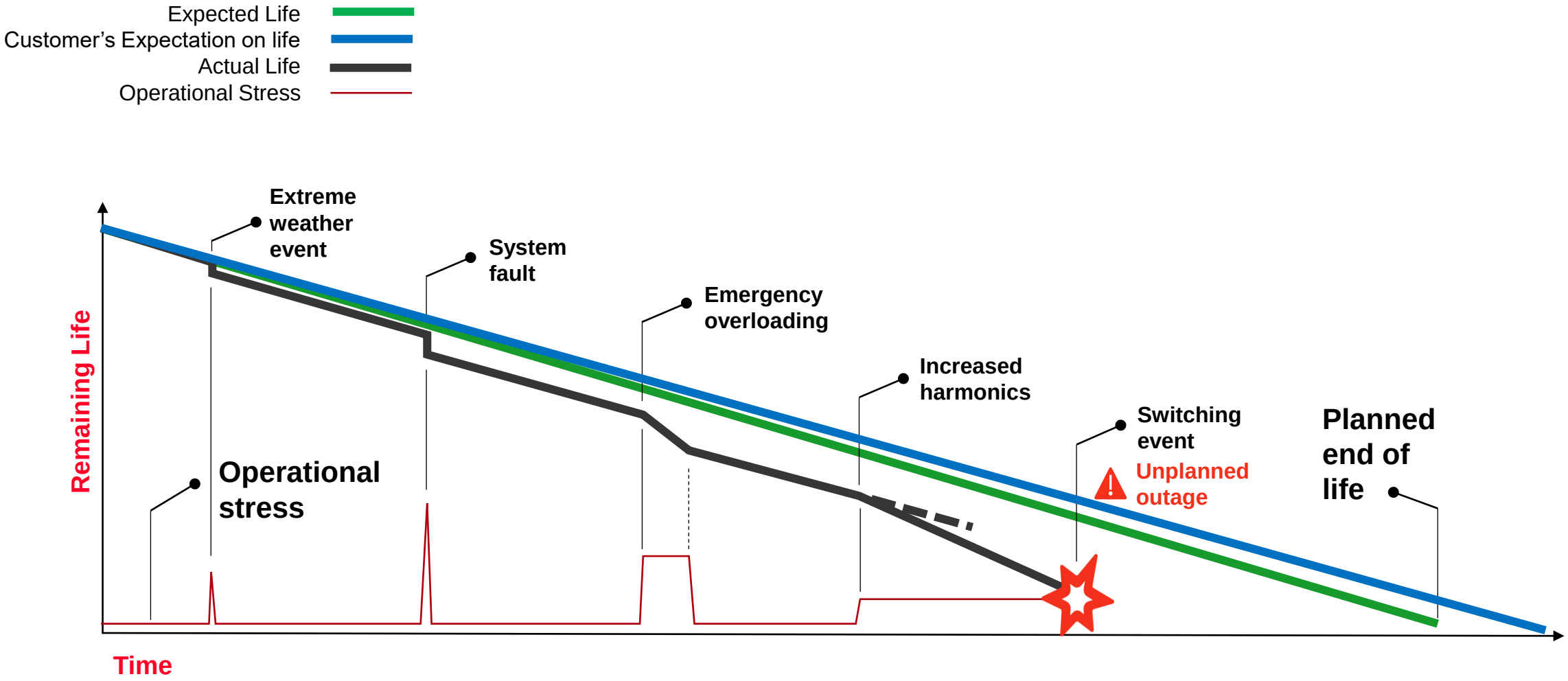
Principles in line with ISO 55000: Get the balance correct

Productivity		Dispatch information about job, asset, tools, parts, history Capture information for better analysis & decision making Reduce job backlog, wasted time & rework; improve production, up-time
Cost		Efficiency & effectiveness Reduce overtime, contractors, third-party services Avoid/shorten outages & shutdowns
Safety		Detection and prevention – incidents, accidents, defects Permits, approvals, risk assessments, job processes, visual guides Intelligent scheduling and dispatch based on skill, location, availability
Governance		Enforce business processes and policies Meet regulatory guidelines, safety and environment concerns Activities performed safely, efficiently & effectively with an audit trail
Visibility		Monitor the assets, work and workforce Visible status and progress, Improved scheduling and response Record accurate, reliable data on the job

Asset Useful Life Expectation



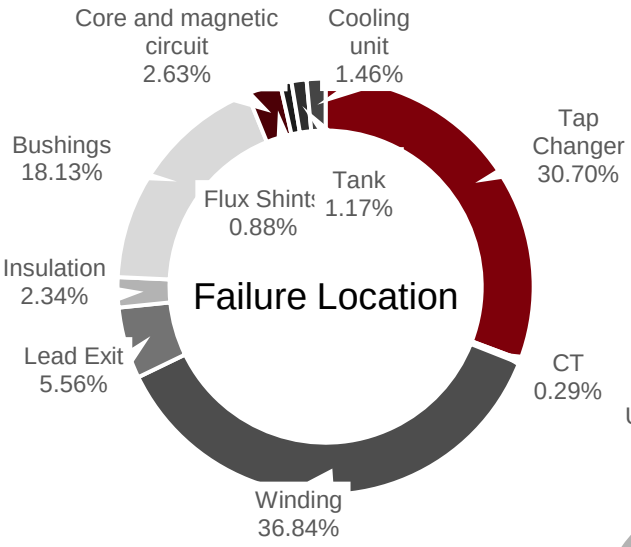
Asset Probability of Failure

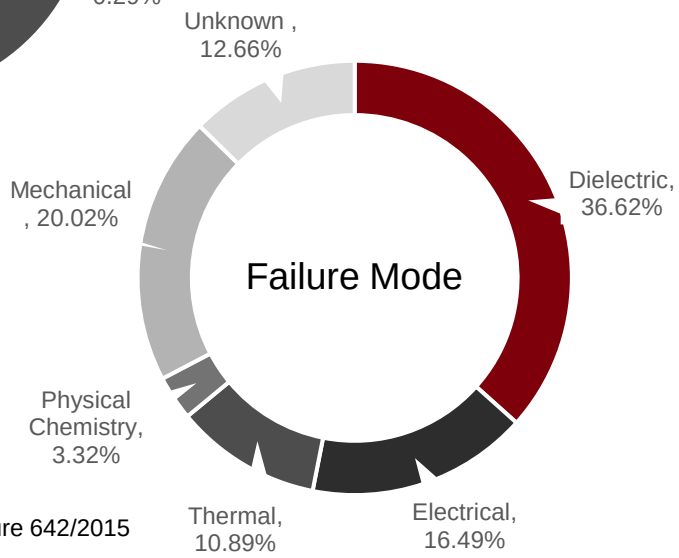
Transformers Failure Rates Statistics

Investigated population and failure rates of substation transformers

FAILURES & POPULATION INFORMATION	HIGHEST SYSTEM VOLTAGE						
	69 kV-99kV	100 kV-199kV	200 kV-299kV	300 kV-499kV	300 kV-699kV	above 700 kV	All
Number of Utilities	11	38	31	27	3	4	58
Number of Transformers	2,962	10,932	4,272	3,233	434	348	22,181
Transformer-Years	15,267	64,718	37,017	25,305	4,774	2,991	150,072
Major Failures	144	280	186	152	27	10	799
FAILURE RATE	**0.94%**	**0.43%**	**0.50%**	**0.60%**	**0.57%**	**0.33%**	**0.53%**

Based on statistical data provided by IEEE - ” A Worldwide Transformer Reliability Survey” and Cigre “ - WG A2.37, Transformer Reliability Survey”





Source: Cigré SCA2.37 Report Technical Brochure 642/2015 Transformer Reliability Survey

Need to manage Asset Performance to ensure its reliability and avoid unplanned breakdown

Managing Asset Performance need to review, interpret, analyze asset operation and maintenance data

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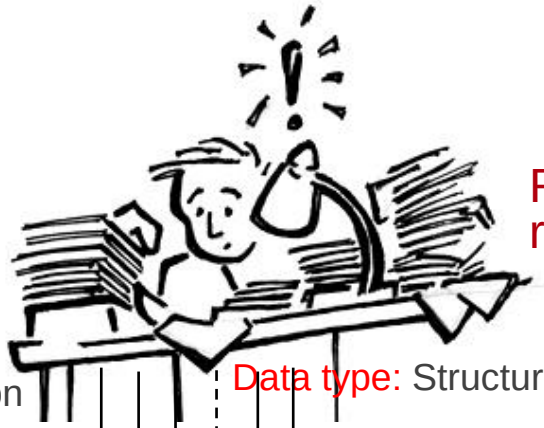

Reliant on human experts for manual review and trend identification

Time/usage-based operation and maintenance Data

Data type: Structured, Unstructured

Others from Inspections that could be in a mix of paper-based records, spreadsheets or mobile devices

Equipment sensor alarms Data

Tests Data

Other Data, e.g. from external sources

Others from Industrial Enterprise systems

Asset Information and Data come from everywhere to be interpreted

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Data and process chaos...

...leads to impossible decisions

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How do organizations **prioritize**?

Last minute unplanned work orders can cost **more** than planned work.

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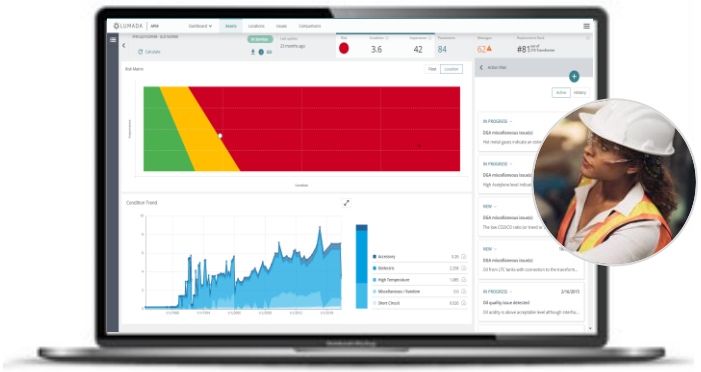
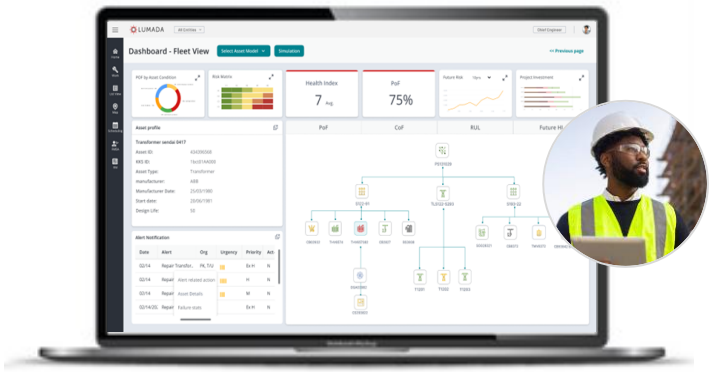
Lumada Asset Performance Management (APM)





HEALTH

Previously known as “Health & Prognostics”

We help you visualize **asset** condition through data-driven modeling and prognostics to maximize uptime across your operations.

Short term ◆ Operational

RELIABILITY

Previously known as “Reliability Manager”

We help you implement **system** reliability engineering methodologies to drive safe, reliable and compliant operations.

Medium term ◆ Tactical

OPTIMIZATION

Previously known as “Strategy Manager”

We help you optimize **portfolio** resources to balance performance, risk & cost to achieve your business objectives.

Long term ◆ Strategic

NOTE: Every business is unique! Consult with one of our experts to see if your business is better suited for a more advanced module.

Asset Management Excellence

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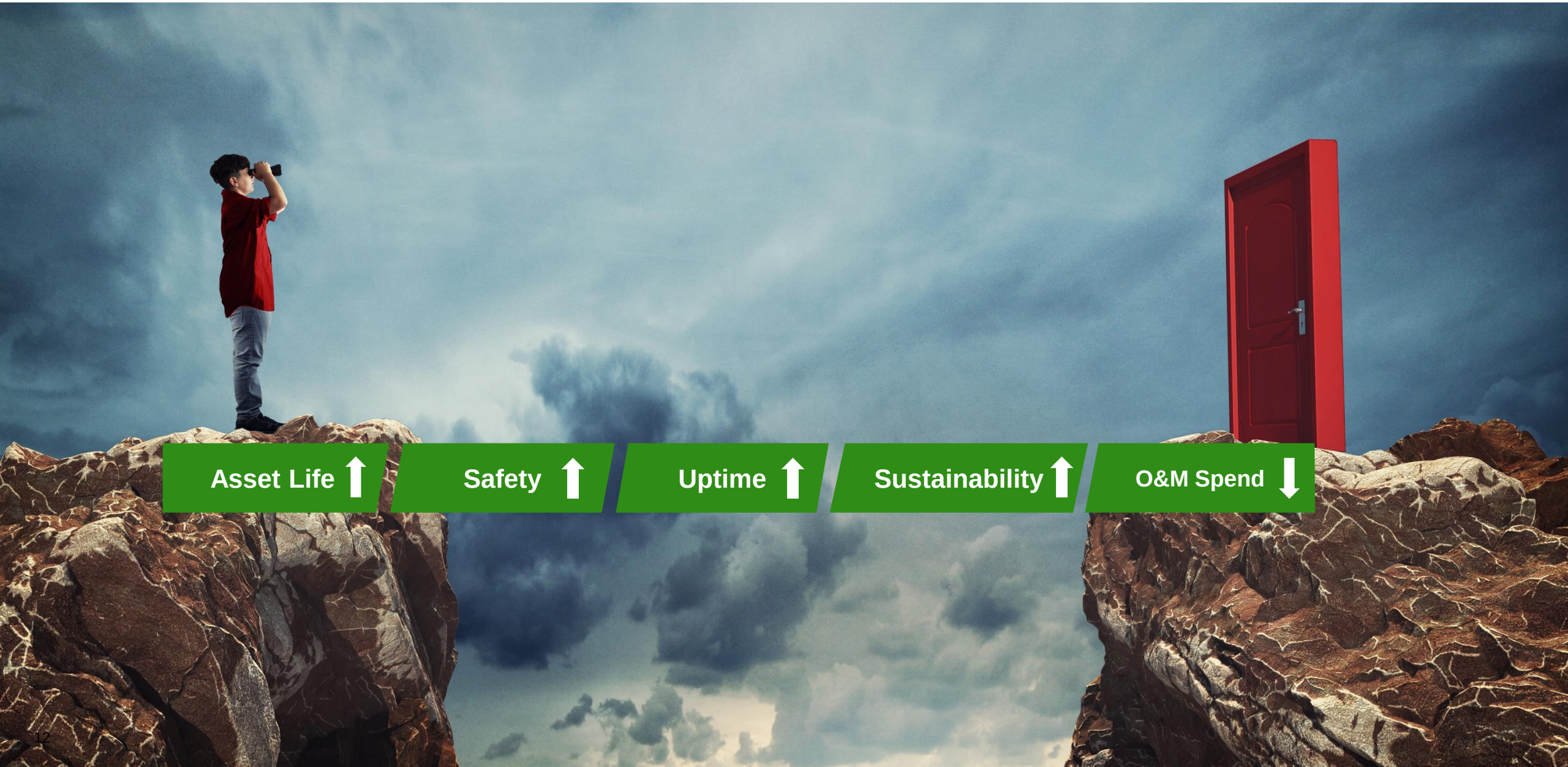
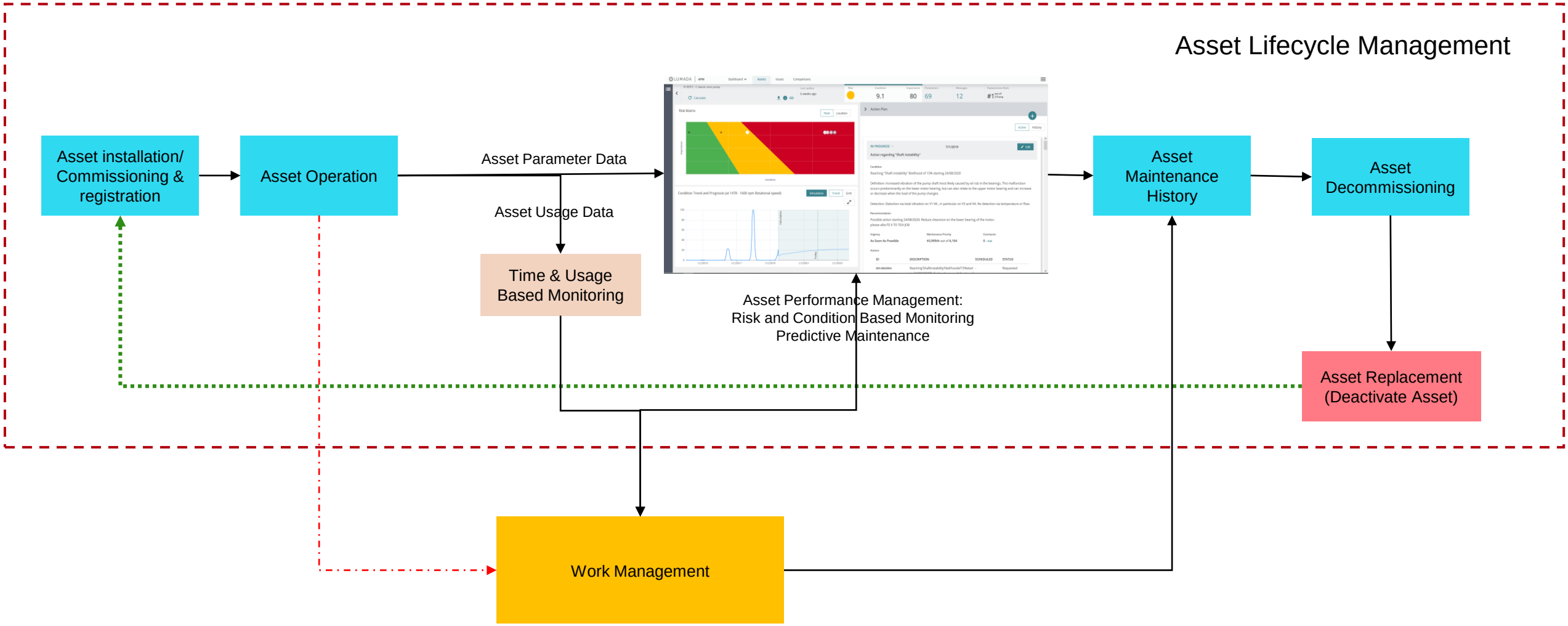


Lumada APM along the Asset Lifecycle Management



Maintenance Strategy Maturity

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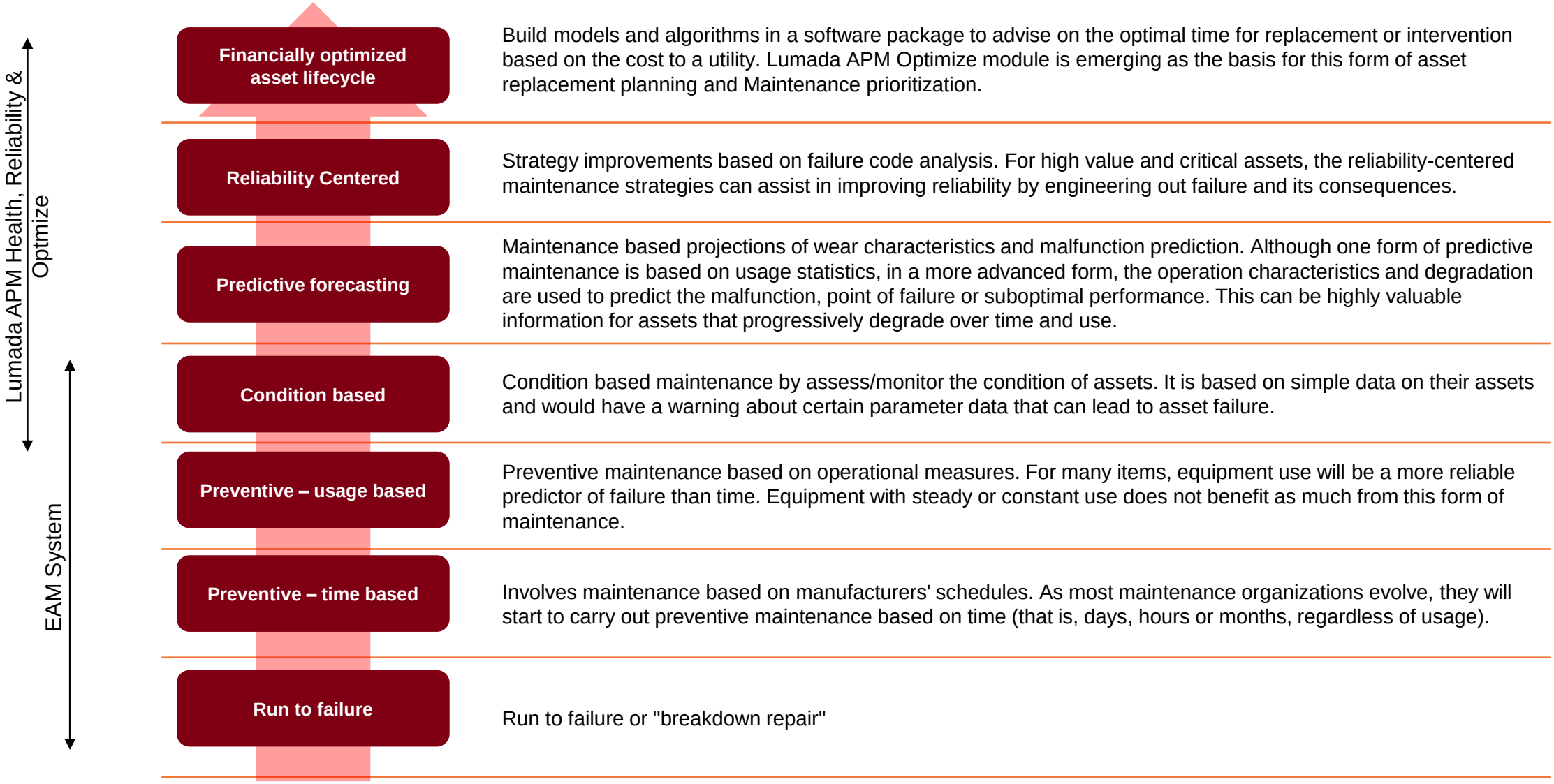

Source: Gartner

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Evolution of Digital Business and Analytics

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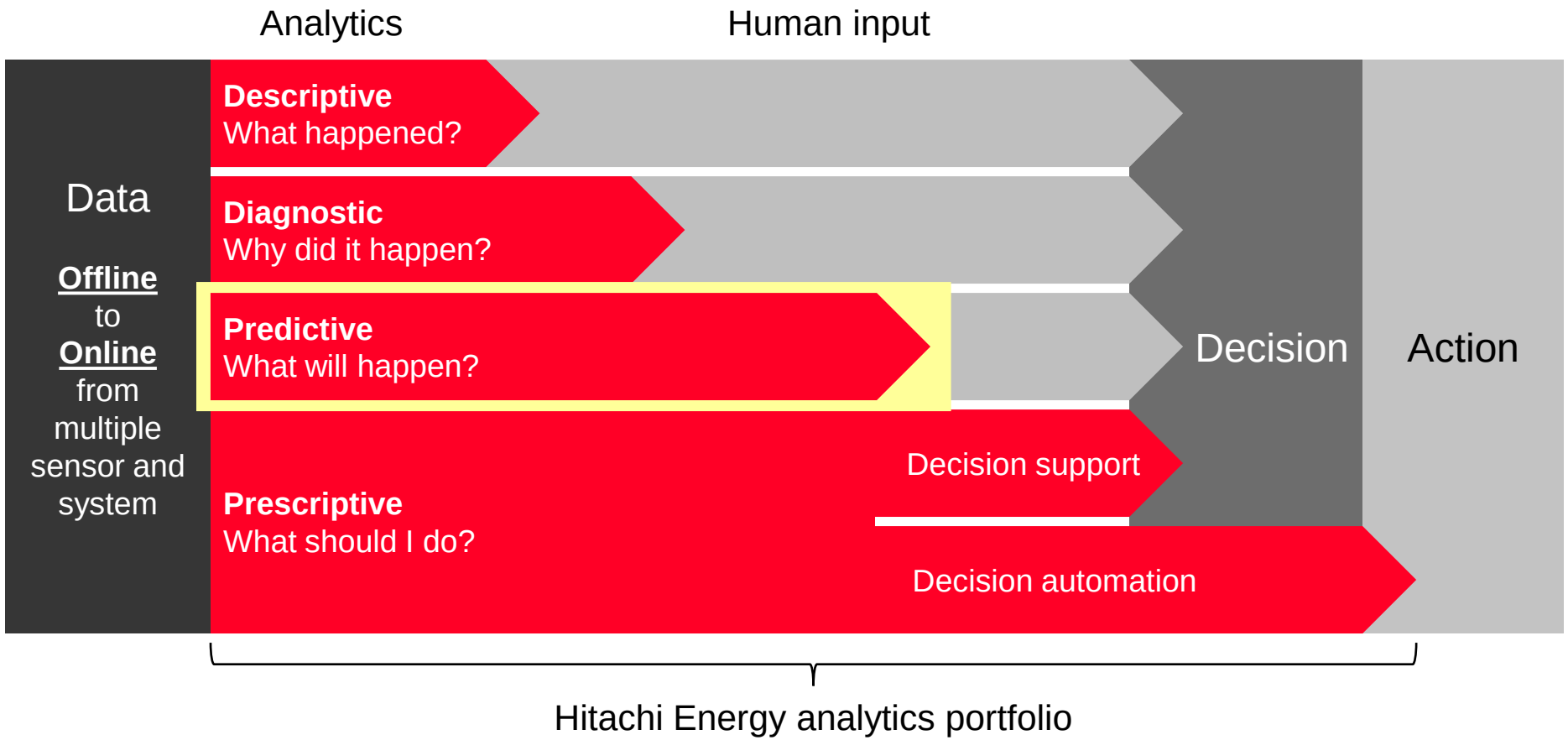
Need for operational improvement steers analytics from descriptive to predictive



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Predictive technologies differ significantly in their prognostic horizon

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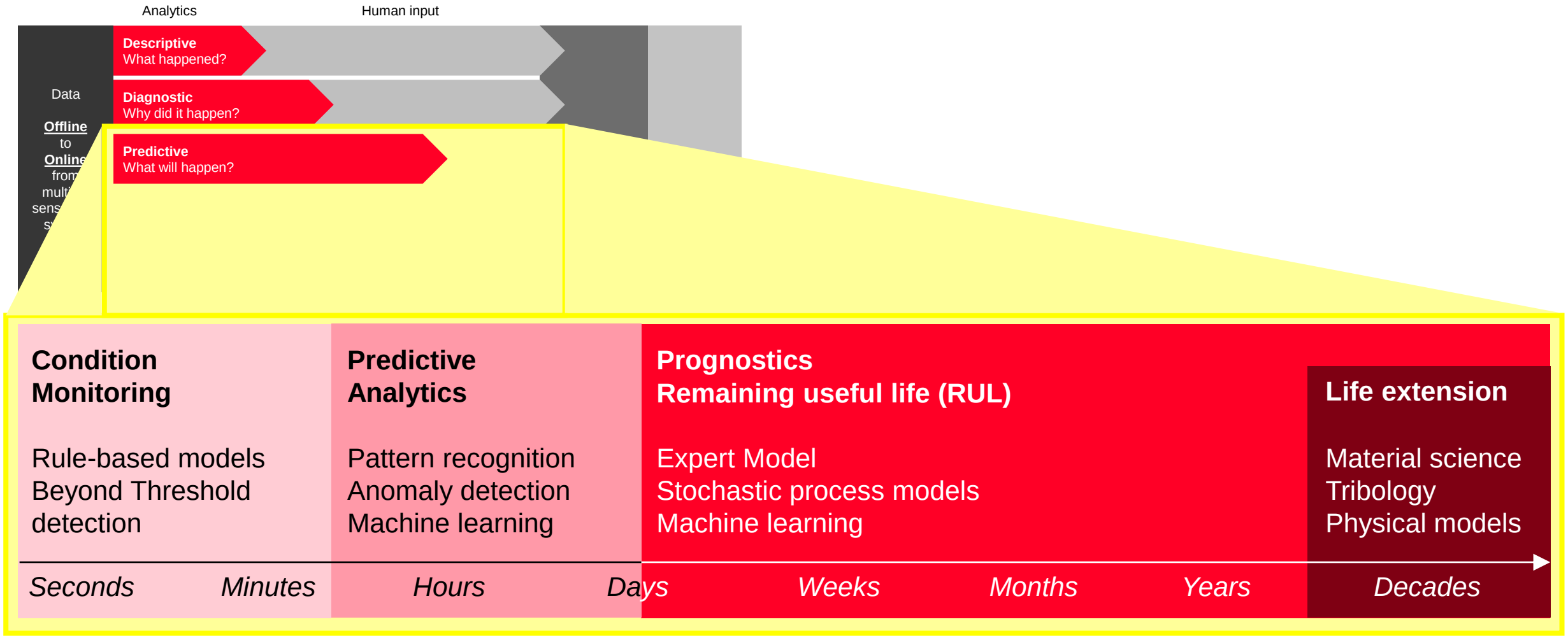
Prognostic solutions offer future risk profiles over months – more than early warnings of imminent failure



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Lumada Asset Performance Management

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Enterprise asset health analytics to improve processes through risk-based optimization

Expert models
Analysis of all assets in the fleet in a geospatial or tabular view (Hitachi Energy, third party)

Advanced operational business intelligence
Optimize decision making based on predictive and prescriptive analysis

Maintenance management
Prioritize maintenance or replacement and automate work requests

Feed data into analysis stage to re-start the cycle

01 **Analyze** → 02 **Anticipate** → 03 **Inform** → 04 **Act** → 05 **Track** → 06 **Connect / collect** → 07 **Re-start the cycle**

Prognostic models
Simulate risk, asset health and probability of failure based on loading of assets

Asset's risk identification
Issues tracking to ensure any identified risks are mitigated and resolved

All data sources:
- Databases
- Historian
- Sensors
- EAM

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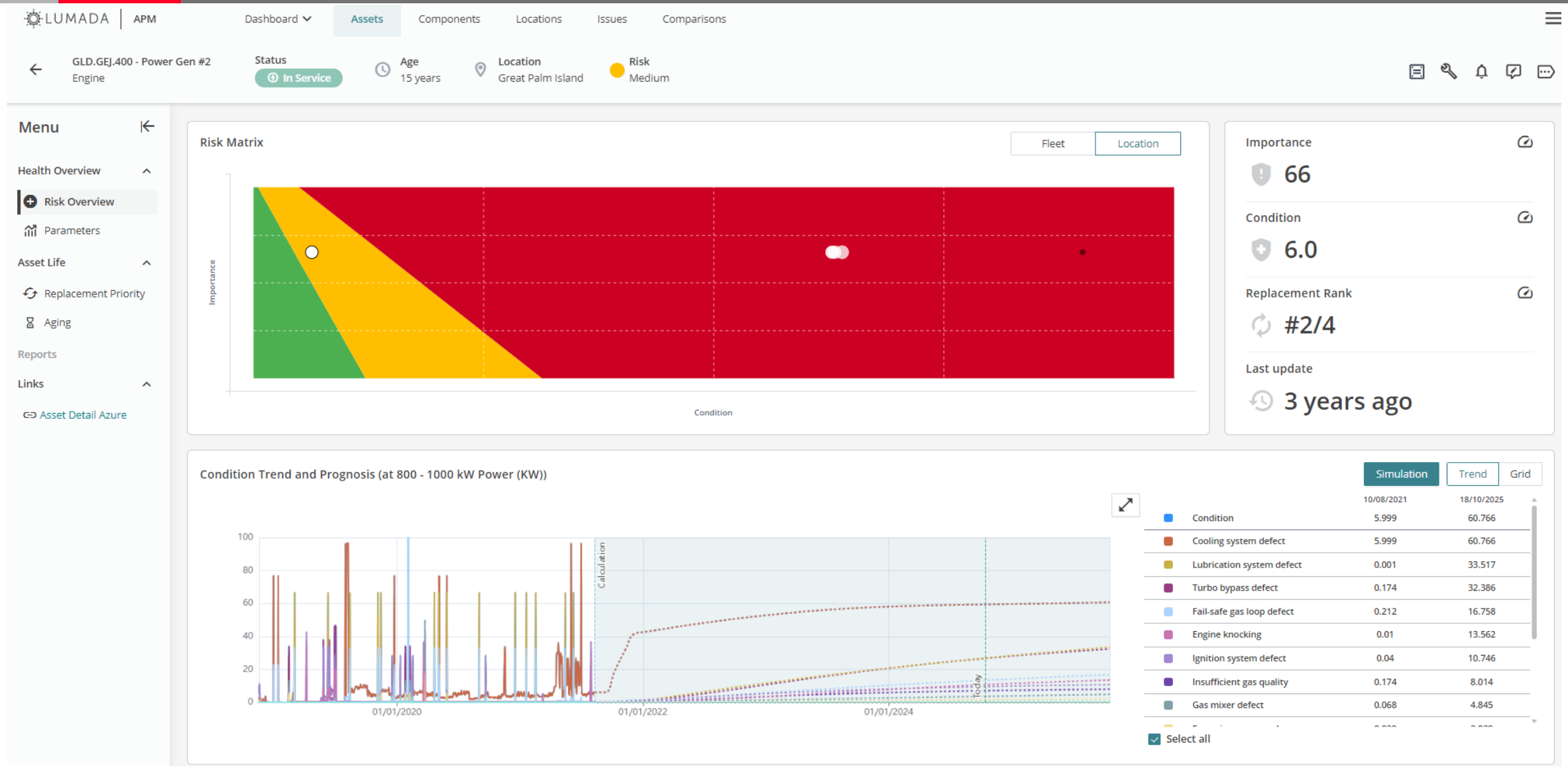
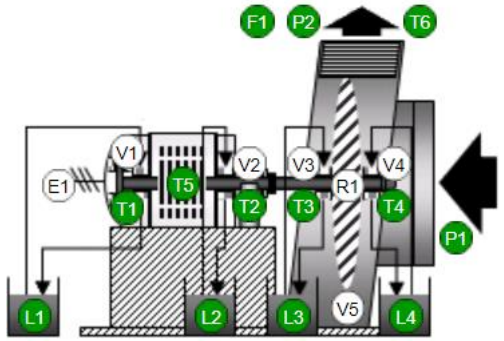
Lumada APM – Asset Risk, Issues and Condition information

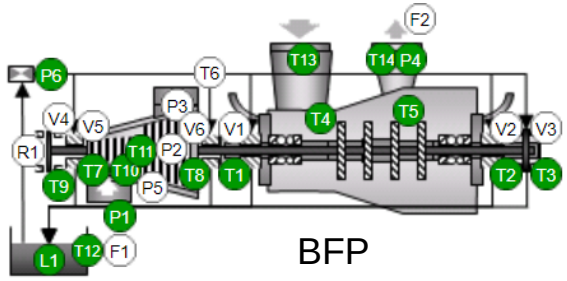


Steam Turbine Power Plant: Asset, Component and Data



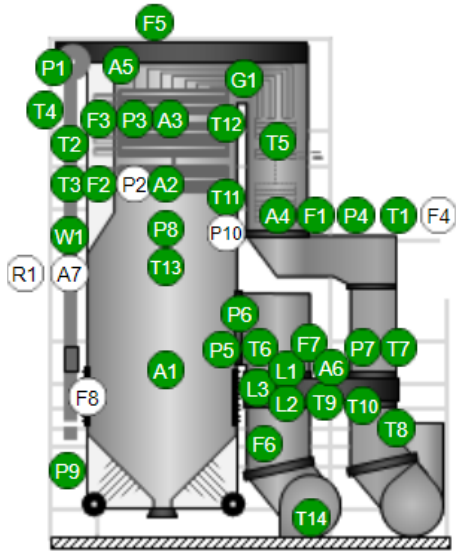
FDF & IDF

Motor
Axle shaft
Radial bearing
Axial bearing
Rotor
Rotor casing
Oil tank
Oil pump
Air flow



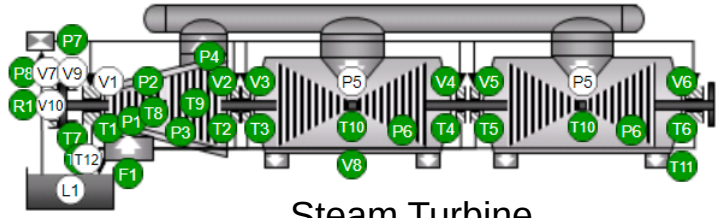
BFP

Vibration data
Temp. data
Pressure data
Lubricant data
Speed data
Flow data
Barrel case
Turbine
Axle shaft
Radial bearing
Axial bearing
Mechanical seal
Oil pump
Oil tank
Direction of flow



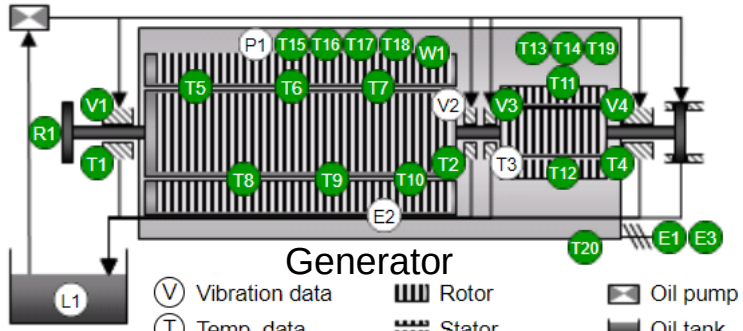
Boiler

Furnace
Superheater
Reheater
Economizer
Steam drum
Air heater
Forced draft fan
Induced draft fan
Water wall drum
Main steam line
Firing system
Ash pit



Steam Turbine

Vibration data
Thermal data
Lubricant data
Pressure data
Speed data
HP/IP turbine
LP turbine
Axle shaft
Radial bearing
Axial bearing
Oil pump
Oil tank
Crossover pipe
Flow direction



Generator

Vibration data
Temp. data
Lubricant data
Speed data
Electrical data
Water chemistry
Rotor
Stator
Axle shaft
Radial bearing
Axial bearing
Oil pump
Oil tank

Lumada APM Prognostics Model for Steam Turbine

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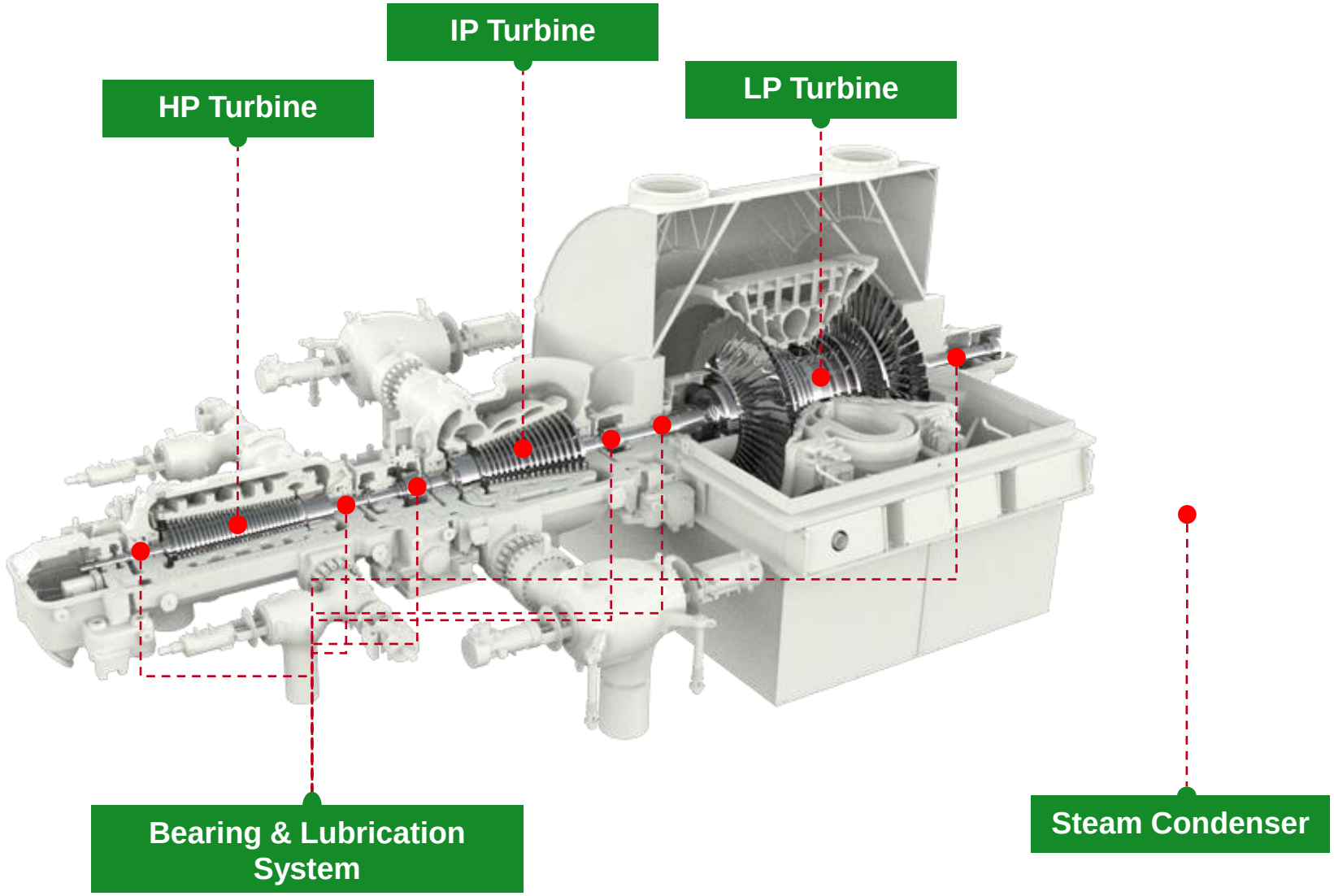

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Lumada APM Prognostics Model for Steam Turbine – High Pressure Turbine

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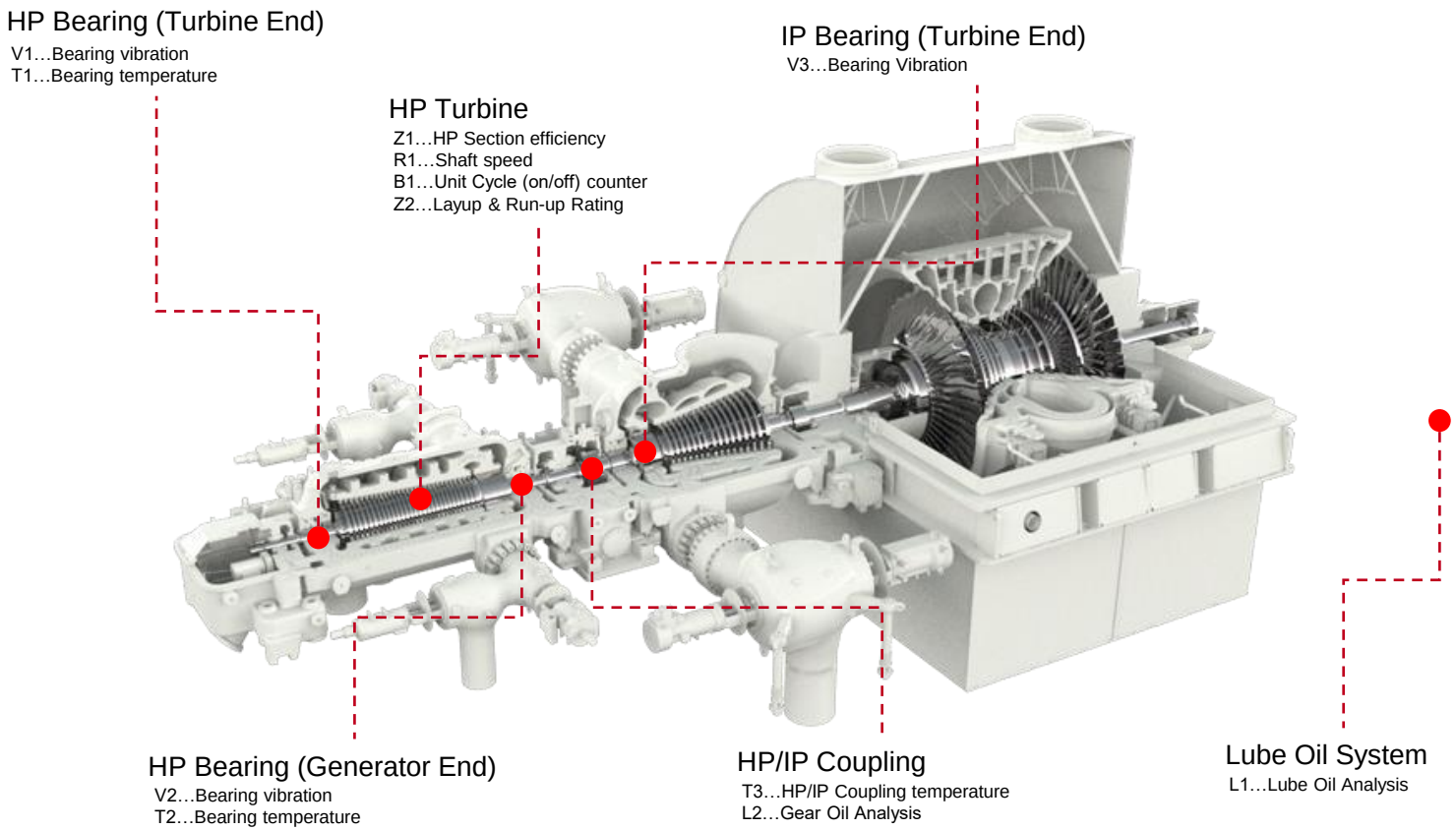
3 Temperature measurements
2 Lubrication measurements
3 Vibration measurements
1 Speed sensor

Malfunction Modes	Data Source
HP Turbine: Solid Particle Erosion (SPE)	Z1 B1 Z2 V1
HP Turbine: Blade Cracking	B1 Z2 V1
HP Turbine: Rotor Imbalance	V1 T1 V2 T2 L1
HP Turbine: Rotor Misalignment	V1 T1 V2 T2 L1 T3
HP Turbine: Rotor Rub	Z1 V1 V2
HP Turbine: Rotor Bow	V1 T1 V2 T2 L1
HP/IP Coupling Deterioration	V2 T3 L2 V3

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

7 malfunction mode templates

40 Plus Raw and Calculated Parameter types



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Lumada APM Prognostic Model

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Lumada APM Prognostics for Steam Turbine – Intermediate Pressure Turbine

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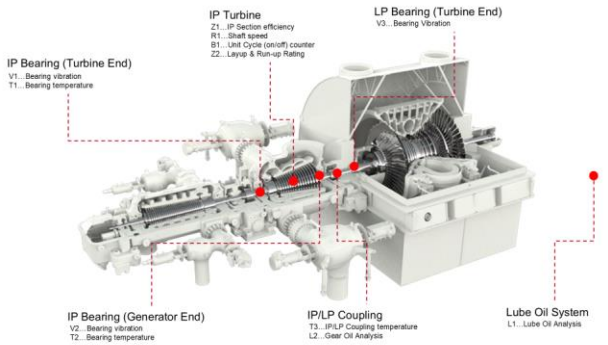
3 Temperature measurements
2 Lubrication measurements
3 Vibration measurements
1 Speed sensor

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

7 malfunction mode templates

40 Plus Raw and Calculated Parameter types

Malfunction Modes	Data Source
IP Turbine: Solid Particle Erosion (SPE)	Z1 B1 Z2 V1
IP Turbine: Blade Cracking	B1 Z2 V1
IP Turbine: Rotor Imbalance	V1 T1 V2 T2 L1
IP Turbine: Rotor Misalignment	V1 T1 V2 T2 L1 T3
IP Turbine: Rotor Rub	Z1 V1 V2
IP Turbine: Rotor Bow	V1 T1 V2 T2 L1
IP/LP Coupling Deterioration	V2 T3 L2 V3



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Lumada APM Prognostics for Steam Turbine – Low Pressure Turbine

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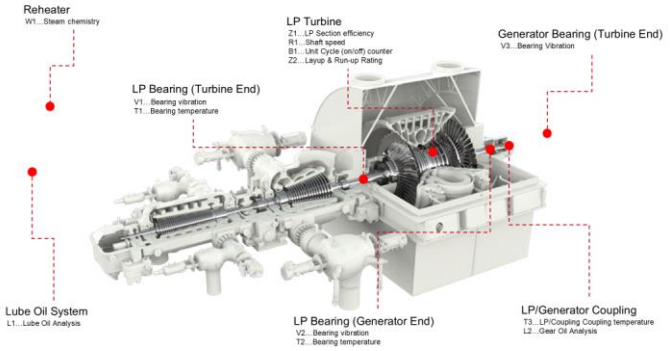
3 Temperature measurements
2 Lubrication measurements
3 Vibration measurements
1 Gas Analysis
1 Speed sensor

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

7 malfunction mode templates

40 Plus Raw and Calculated Parameter types

Malfunction Modes	Data Source
LP Turbine: Blade Cracking	W1 B1 Z2 V1
LP Turbine: Water Droplet Erosion	B1 Z1 V1
LP Turbine: Rotor Imbalance	V1 T1 V2 T2 L1
LP Turbine Rotor Misalignment	V1 T1 V2 T2 L1 T3
LP Turbine: Rotor Rub	Z1 V1 V2
LP Turbine: Rotor Bow	V1 T1 V2 T2 L1
LP/Generator Coupling Deterioration	V2 T3 L2 V3



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Lumada APM Prognostics for Steam Turbine – Bearing & Lubrication System

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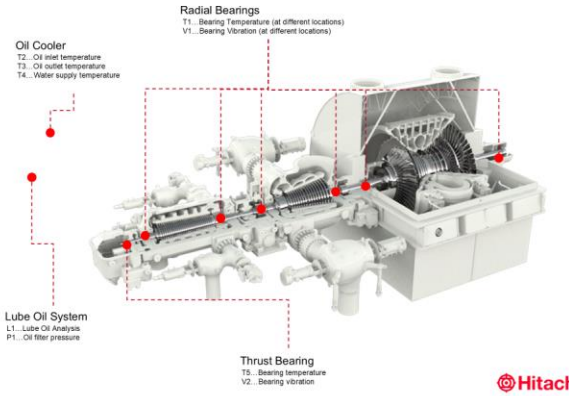
5 Temperature measurements
1 Lubrication measurements
2 Vibration measurements

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

7 malfunction mode templates

25 Plus Raw and Calculated Parameter types

Malfunction Modes	Data Source
Lubricant Contamination Solids	T1 V1 L1
Lubricant Contamination Liquids	T1 V1 L1
Lubricant Wear	T1 V1 L1
Lubricant Spec Failure	T1 V1 L1
Mechanical Bearing Degradation	T1 V1 L1
Oil Cooler Malfunction	T1 T2 T3 T4 P1 V1
Thrust Bearing Deterioration	T5 V2 L1



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Lumada APM Prognostics for Steam Turbine – Steam Condenser (Water cooled)

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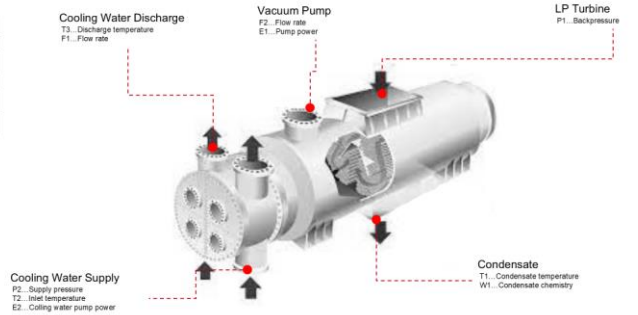
3 Temperature measurements
2 Pressure measurements
1 Water chemistry analysis measurement
2 Flow measurements
2 Electrical measurements

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

5 malfunction mode templates

10 Plus Raw and Calculated Parameter types

Malfunction Modes	Data Source
Excess Air in Leakage	W1 T1 T3 F2 E1
Vacuum Pump Deterioration	W1 T1 T3 F2 E1
Condenser Tube Fouling	W1 T1 T3 F1 F2 E2
Condenser Tube Steam Side Deposition	W1 T1 T3
Condenser Leakage	W1



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Lumada APM Model Configuration and Validation

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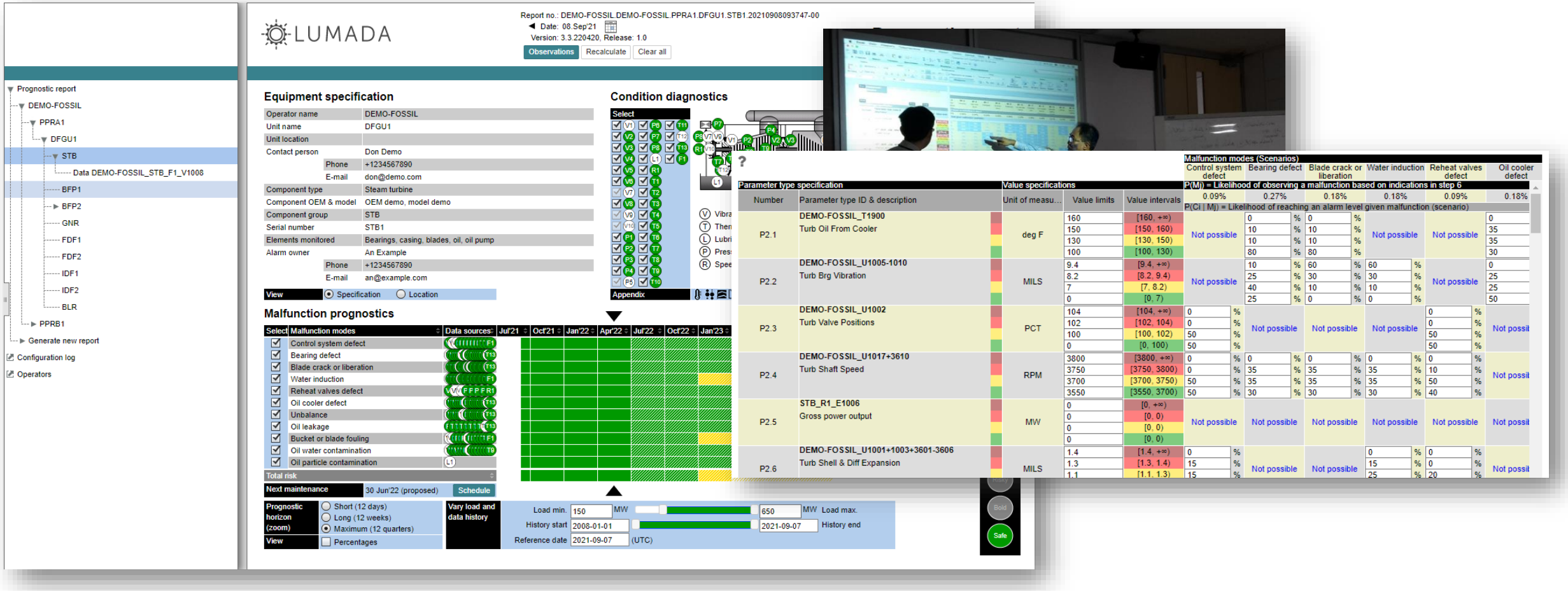
Creation, validation and management of prognostic APM performance models



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Lumada APM Prognostics – Asset Failure Time Window

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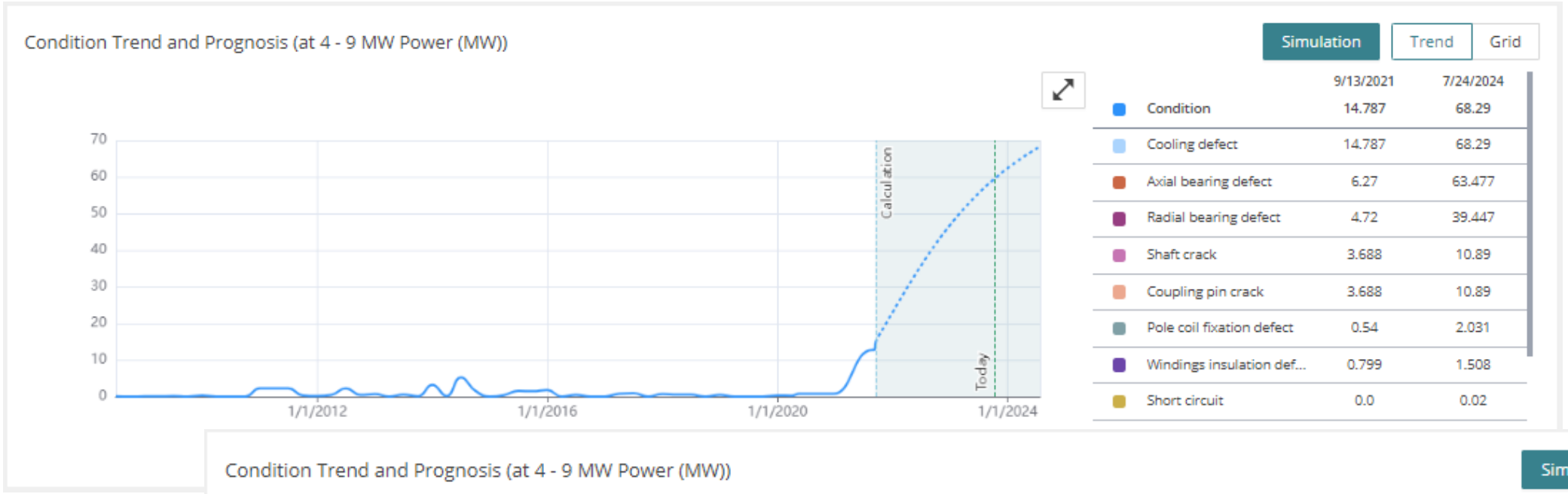
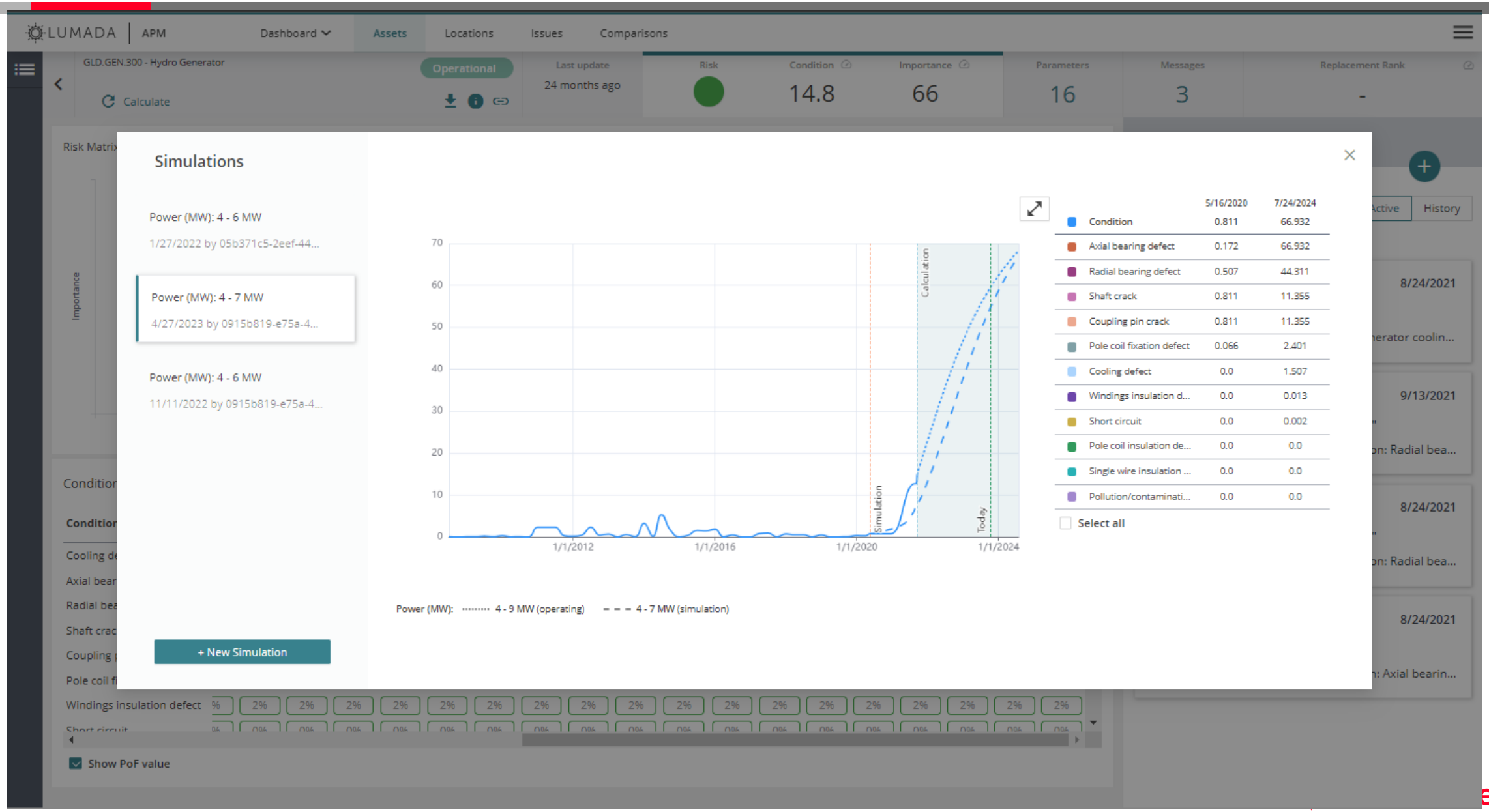


Lumada APM Prognostics – Operation Simulation and its Failure Time Window



Lumada Asset Performance Management

Prognosticating malfunctions from fleet to component

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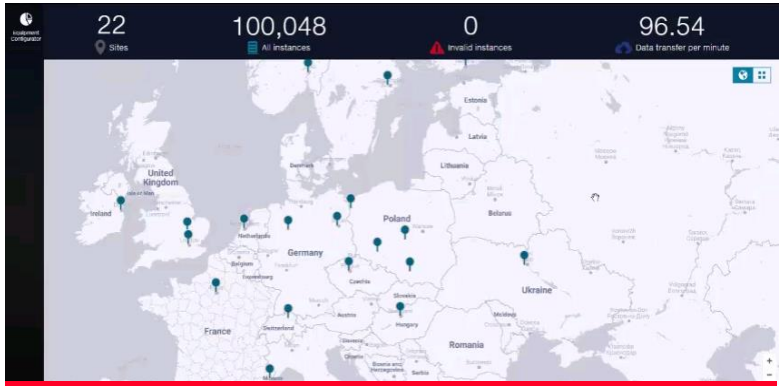
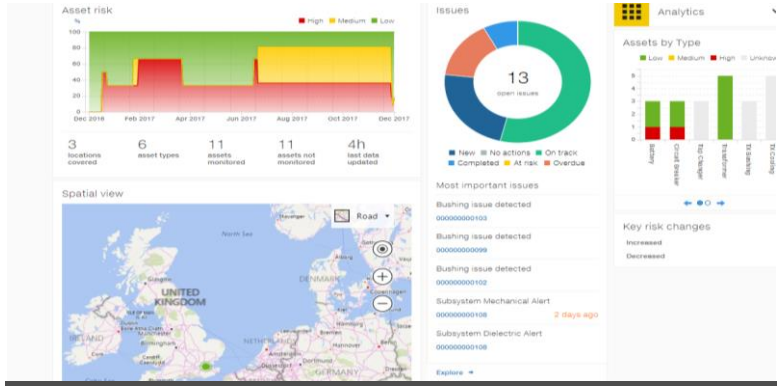
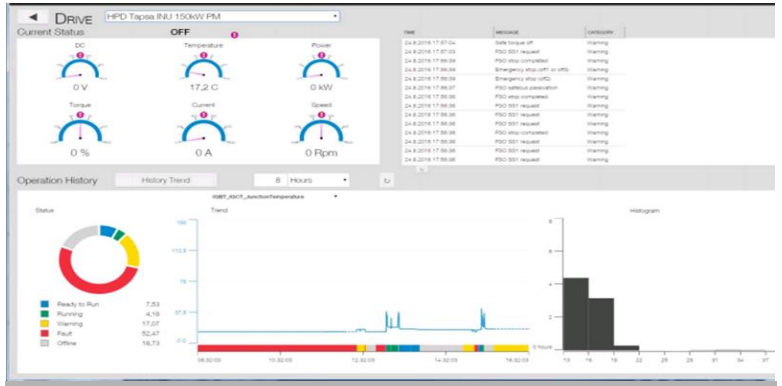
Monitoring asset health from fleet to component



Fleet

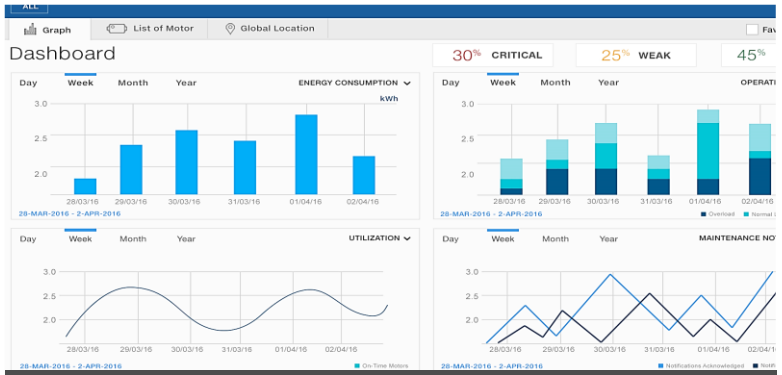


Unit

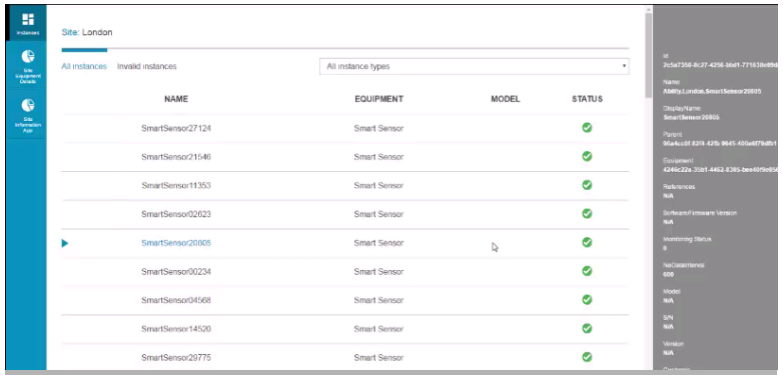


Component

Fleet



Unit



Component

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Lumada APM Use Cases

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Use Case

1. Having ageing critical asset
2. Need to improve workforce productivity
3. Need decision support for Asset maintenance prioritization
4. Need decision support for Asset replacement planning
5. Having limited asset expert to analyze critical asset condition
6. Having limited planned maintenance window time
7. Plan to utilize asset data from multiple systems to analyze asset condition
8. Dx in the maintenance activities

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Key Benefits of Lumada Asset Performance Management

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Transform real-time and historical asset data into strategic insights on the health of your mission critical assets

Top Benefits		Lumada APM can help..
Asset Health Monitoring	→	**Consolidate data on assets and their condition and make available to key stakeholders in timely manner**
Decision Support on Maintenance	→	**Deployment of advanced decision support tools**
Avoid Catastrophic	→	**Provide visibility and increased awareness of potential failures to support operational decision making**
Improve Budget Utilization	→	**Information availability enables maintenance to be delayed on healthy assets**
Maintenance Strategy	→	**Provide a path and strategy to applying condition-based maintenance strategy to asset portfolio**
Deferr CAPEX & Reduce OPEX	→	**Optimizes the overall CAPEX and OPEX spending using maintenance priority and replacement score**

Benefit Realization while maintaining High Reliability

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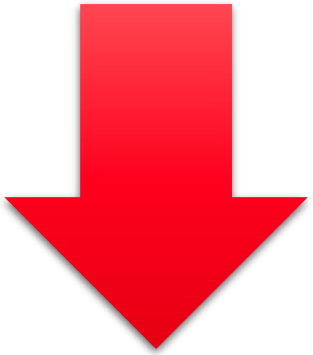
Leading Factor for Cost Saving and Cost Avoidance

- Prevent Catastrophic Failure
- Avoid unplanned breakdown
- Extend asset life
- Understand asset health and risk for each individual asset
- Better understanding on the required Maintenance
- Visibility on the overall asset risk
- Visibility in the Maintenance priority
- Information for the replacement priority
- Etc.



Potential Cost Avoidance

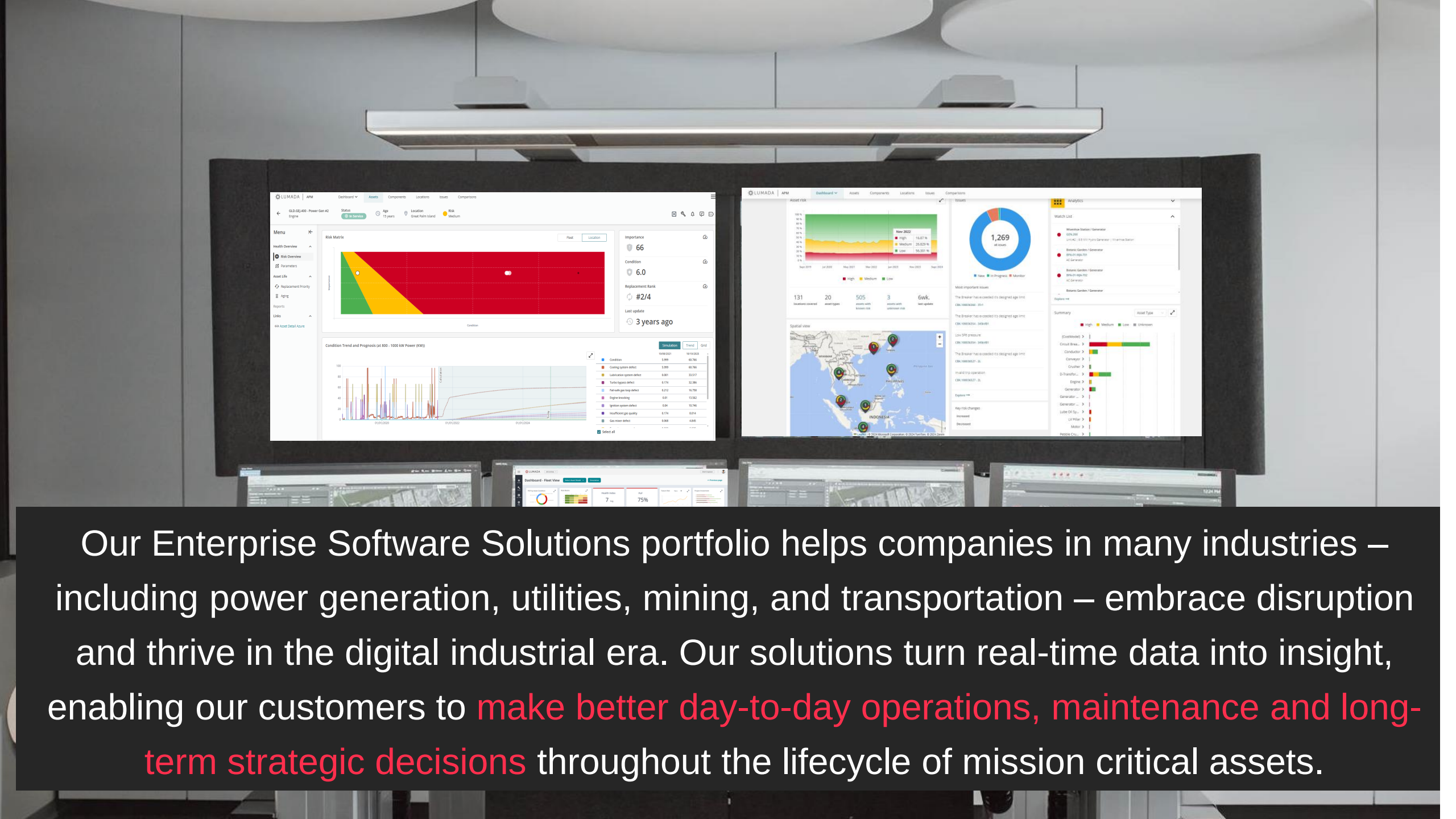
- Deferred Capital expenditure
- Avoid unplanned Capex for replacement
- Avoid Loss of Revenue

Potential Cost Saving

- Better Maintenance Budget Allocation & potential reduction
- Downtime Reduction
- Maintenance Cost Reduction

Benefit Realization

Hitachi Energy

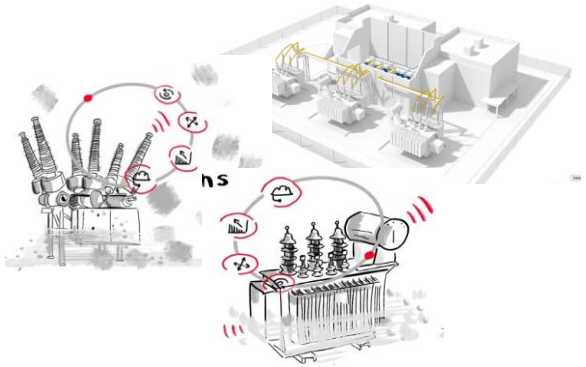


Our Enterprise Software Solutions portfolio helps companies in many industries – including power generation, utilities, mining, and transportation – embrace disruption and thrive in the digital industrial era. Our solutions turn real-time data into insight, enabling our customers to make better day-to-day operations, maintenance and long-term strategic decisions throughout the lifecycle of mission critical assets.

Hitachi Energy provides a bridge between operational future and its digital aspirations

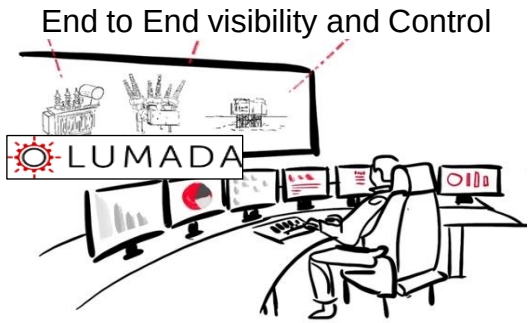
HITACHI
Inspire the Next

Fully Digital Portfolio



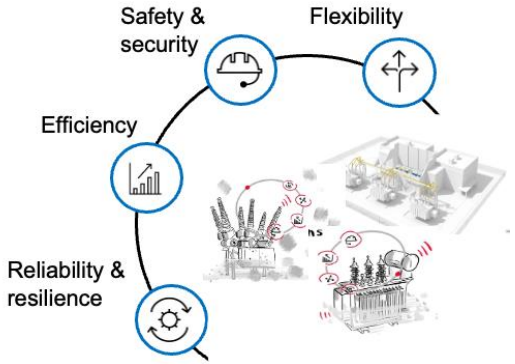
Data

Software & Digital Services



Enables

Customer Value



Connected products

- Smart products share information on performance, state and condition
- Secure, scalable communications
- Open architectures allow easy of multivendor integration

Software-enabled solutions

- Visibility & control across systems
- Reduced Data silos and easy integration of legacy systems
- Scalable, flexible control systems from Edge to Core
- System risk management
- Simple to understand visualization & guided maintenance

Improved control over the entire business

- Business process automation
- Reduced O&M costs
- System reliability & Efficiency
- Optimized maintenance activities
- Extended life of systems and assets

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