

# MindSphere

## Asset Performance Monitoring

### Benefits

- Increase operational transparency across machines, systems and sites
- Improve productivity
- Lower maintenance, repair, replacement and inventory costs
- Improve reliability and maintainability of assets
- Maximize uptime and availability of assets
- Protect workplace safety by identifying potential asset failures in advance

### Features

- Configurable and intuitive multi-site management
- Near real-time, status-based condition monitoring of high-value assets
- Multi-condition, rule-engine-based early warning detection framework for assets
- Workflow-based event management for organized and transparent maintenance and service activities
- Out-of-the-box KPI calculations to outline industrial procurement and operating characteristics of assets

### Increase operational transparency, improve productivity and lower maintenance costs of industrial assets

#### Summary

Asset Performance Monitoring is a MindSphere application that enables tracking key operating parameters of industrial assets to detect and alert users to deviations from normal operation conditions. With Asset Performance Monitoring, customers of all sizes can capitalize on Internet of Things (IoT) data, and benefit from maximum uptime and availability of machines and increased operational transparency.

#### Current situation

Improving productivity for a single industrial asset is difficult when it suffers unplanned downtime due to failure. This gets more challenging when there is a group or fleet of heterogeneous assets. This challenge stems from the lack of transparency into machine performance required to predict and prevent failures in the field. Asset maintenance also becomes challenging when the operational costs of outdated machinery mount in terms of more frequent maintenance, repairs, onsite replacements and hard-to-find spare parts. Further, it is becoming increasingly difficult as the people who have the engineering and maintenance know-how are retiring at a rapid pace.

### Challenges

Customers who do not have the MindSphere Asset Performance Monitoring application are quite likely using reactive and expensive unplanned maintenance services for their machines and setups. Some customers go for the custom in-house platforms and applications that provide limited transparency and flexibility. Developing, maintaining and upgrading these solutions can be costly and also divert the company and employee focus from their core competencies and mission.

### Solution

Asset Performance Monitoring is a feature-rich MindSphere application based on a wide range of digital services, and is designed to provide an intuitive user experience. The application enables customers to realize operational transparency across machines, systems and sites. Customers can connect, collect and analyze data from aging as well as leading infrastructures to immediately monitor assets on a configurable and intuitive multi-site dashboard. Near real-time status monitoring of critical assets enables maintenance teams to minimize downtime.

Customers can become more proactive in their asset maintenance practices when they have an early problem detection framework based on a multi-condition rule engine. Customers can protect the health and safety of employees and

# MindSphere Asset Performance Monitoring

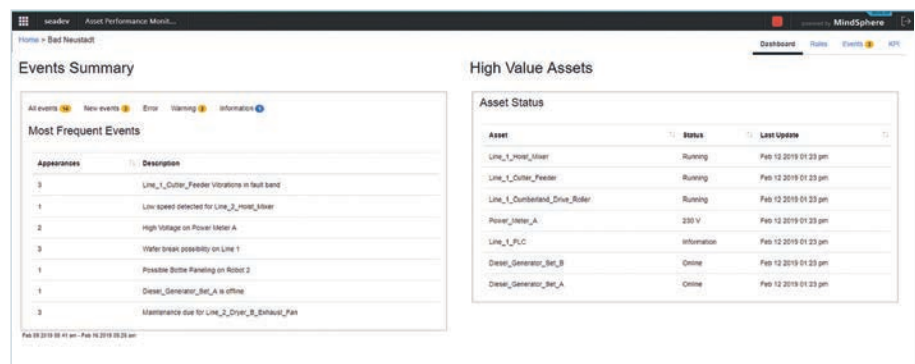
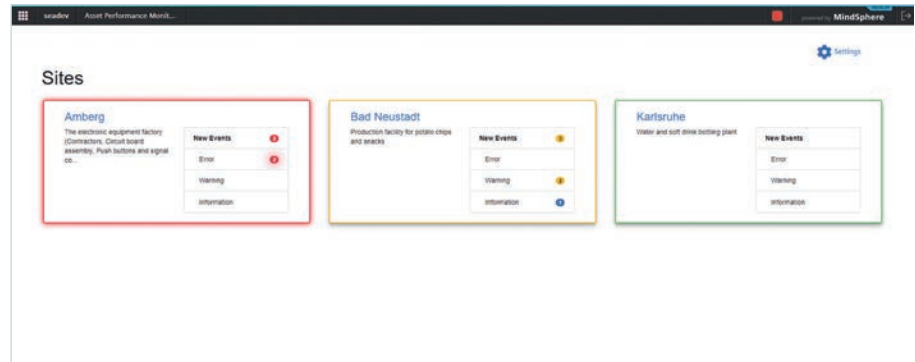
environment by avoiding undesirable asset incidents. Workflow-based event management makes it easier to coordinate maintenance and service activities. Out-of-the-box (OOTB) key performance indicator (KPI) calculations make it possible to outline the industrial procurement (reliability, availability and maintainability) and operating characteristics of an asset.

These features help make sure skilled field engineers are spending time on asset maintenance whenever needed, and it is cost effective and convenient. The MindSphere Asset Performance Monitoring application is designed to work for multiple industry domains, making it applicable to a wide range of markets and industries.

## Multi-site monitoring

Remote monitoring of multiple sites is easy using the Asset Performance Monitoring application. It reads the IoT data model of your assets from the MindSphere platform, and allows you to set up multi-site and individual site dashboards. Intuitively presenting near real-time updates makes it easy for you to build situational awareness about events at sites.

Each site has its own settings for easy configuration of other features of the application. Monitoring for the individual site can be turned off with one click.



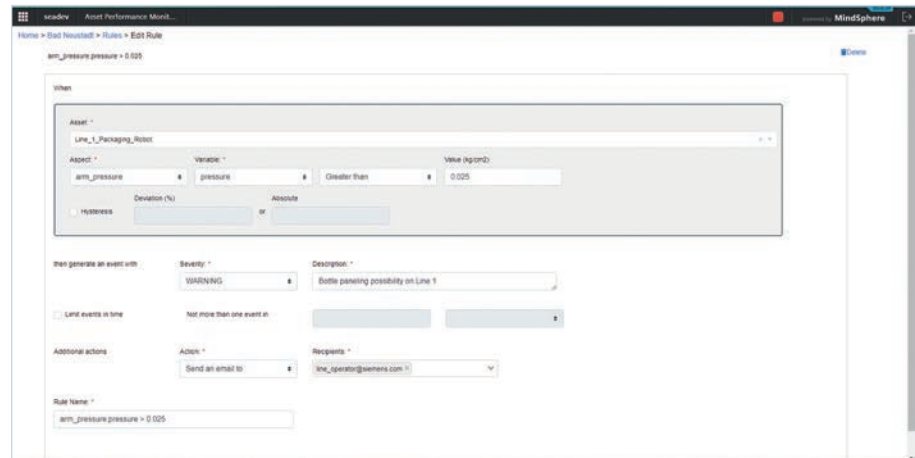
# MindSphere Asset Performance Monitoring

## Rule management

With rule management, you can define, activate and manage single condition and multi-condition rules that process a continuous stream of IoT time-series data from assets, and generate events and notifications. Multi-condition rules allow you to set up a rule to identify warning and fault patterns of conditions across multiple assets. Rule management is a practical early warning detection framework that enables you to become more proactive in your asset maintenance practices.



Rule	Assets	Description	Event Severity	Additional Action	Active
heat temperature > 120(A/speed vibration > 30)	Line_1_Driver_Driver_A Line_1_Driver_Outfeed_Conveyor	Water break possibility on Line 1	warning	EMAIL	<input checked="" type="checkbox"/>
air_pressure pressure > 0.025	Line_1_Packaging_Robot	Bottle packing possibility on Line 1	warning	EMAIL	<input type="checkbox"/>
power_out_voltage < 230	Power_Linear_A	Generator A low Voltage	error	EMAIL	<input checked="" type="checkbox"/>



When

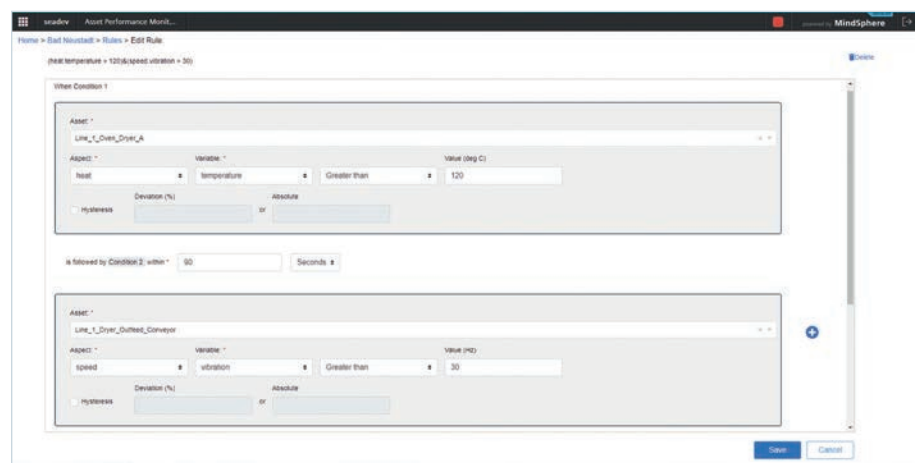
Asset: Line\_1\_Packaging\_Robot

Aspect: air\_pressure Variable: pressure Value (Aggr): Greater than Value (Aggr): 0.025

then generate an event with Severity: WARNING Description: Bottle packing possibility on Line 1

Additional actions: Action: Send an email to Recipients: line\_operator@seemers.com

Rule Name: air\_pressure pressure > 0.025



When Condition 1

Asset: Line\_1\_Driver\_Driver\_A

Aspect: heat Variable: temperature Value (Aggr): Greater than Value (Aggr): 120

is followed by Condition 2 within: 90 Seconds

When Condition 2

Asset: Line\_1\_Driver\_Outfeed\_Conveyor

Aspect: speed Variable: vibration Value (Aggr): Greater than Value (Aggr): 30

# MindSphere Asset Performance Monitoring

## Event management

The event summary view provides a wealth of information about events at the site. Keeping track of events becomes easier with a variety of available filters and sorting options. The built-in workflow allows maintenance supervisors and field engineers to coordinate activities from the application. Event state options enable you to maintain a record of decisions associated with events.

Severity	Timestamp	Description	State	User	Assets	Rule
Warning	Feb 12 2019 01:24 pm	Water break possibility on Line 1	New		Line_1_Driver_Driver_A	(Heat temperature > 120)&(Speed vibration > 30)
Warning	Feb 12 2019 01:24 pm	High voltage on Power Meter A	New		Power_Meter_A	voltage > 250
Warning	Feb 12 2019 01:24 pm	Possible Bottle Panning on Robot 2	Assigned	George Bunt	Line_1_Packaging_Robot	arm_pressure pressure > 0.025
Info	Feb 12 2019 01:24 pm	Maintenance due for Line_1_Driver_B Exhaust Fan	New		Line_1_Driver_B_Exhaust_Fan	Maintenance reminder
Info	Feb 12 2019 01:24 pm	Maintenance due for Line_1_Combustion_Drive Roller	Fixed	George Bunt	Line_1_Combustion_Drive_Roller	Maintenance reminder
Warning	Feb 12 2019 01:24 pm	Low speed detected for Line_1_Hoist_Upper	Fixed	Philipp Falt	Line_1_Hoist_Upper	rpm < 10
Info	Feb 12 2019 01:24 pm	Maintenance due for Line_1_Robot_A	Fixed	Hans-Joerg Pöge	Line_1_Robot_B	Maintenance reminder
Warning	Feb 12 2019 01:24 pm	Line_1_Cutter_Feeder vibrations in fault band	Fixed	Hans-Joerg Pöge	Line_1_Cutter_Feeder	Vibration > 200
Warning	Feb 12 2019 01:24 pm	Diesel_Generator_Set_A is offline	Fixed	Philipp Falt	Diesel_Generator_Set_A	generator status not online
Warning	Feb 12 2019 01:24 pm	Water break possibility on Line 1	Fixed	Hans-Joerg Pöge	Line_1_Driver_Driver_A	(Heat temperature > 120)&(Speed vibration > 30)

## High-value asset monitoring

The seriousness of each event is considered based on its impact on several business levels, including safety, compliance, operations and maintenance cost. Near real-time status monitoring of critical assets enables maintenance teams to minimize downtime.

Using intuitive configuration, you can map raw value from IoT time-series data into a meaningful status for each asset.

Name	Asset Name	Status definitions
<input type="checkbox"/> Line_1_Hoist_Mixer	Line_1_Hoist_Mixer	<input checked="" type="checkbox"/>
<input type="checkbox"/> Line_1_Cutter_Feeder	Line_1_Cutter_Feeder	<input checked="" type="checkbox"/>
<input type="checkbox"/> Line_1_Combustion_Drive_Roller	Line_1_Combustion_Drive_Roller	<input checked="" type="checkbox"/>
<input type="checkbox"/> Power_Meter_A	Power_Meter_A	<input checked="" type="checkbox"/>
<input type="checkbox"/> Line_1_PLC	Line_1_PLC	<input checked="" type="checkbox"/>
<input type="checkbox"/> Diesel_Generator_Set_B	Diesel_Generator_Set_B	<input checked="" type="checkbox"/>
<input type="checkbox"/> Diesel_Generator_Set_A	Diesel_Generator_Set_A	<input checked="" type="checkbox"/>

Configuration for Asset: Line\_1\_PLC

Status Aspect: conveyor\_status

Status Variable: status\_word

Define status values:

Status test	Variable value
Error	3
Warning	2
Information	1

# MindSphere Asset Performance Monitoring

## KPI calculations

Based on a KPI calculation service from MindSphere, this feature enables you to get a unified view of an asset. The MindSphere KPI Calculation Service offers a set of computational procedures based on International Organization of Standardization (ISO) 3977-9:1999. Calculations are done for a given period of time using IoT time-series data and maintenance-calendar data for an asset. The service presents the output in the form of KPI states and factors, which make it possible to outline the industrial procurement and operating characteristics of an asset.

KPI states are composed of asset states that operate for a given period of time: available hours (service hours, reserve shutdown hours), unavailable hours (forced outage hours, planned outage hours), and unknown hours (no data). KPI factors are probability values of availability, reliability and maintainability of asset.

KPI calculation configurations allow you to set up ad hoc calendar entries for the maintenance of each asset. It also allows you to inform the application about different operating states of the asset.

KPI Summary

Asset	Availability Factor (AF)	Reliability Factor (RF)	Mean Time Between Failures (MTBF) (hours)
Line_2_Dryer_Outfeed_Conveyor	95.24%	95.24%	160.00
Line_1_Dryer_Outfeed_Conveyor	94.05%	94.05%	0

Line\_2\_Dryer\_Outfeed\_Conveyor

KPI Values - Hours		KPI Values - Factors	
KPI	Value	KPI	Value
No Data Hours (NoData)	0	Availability Factor (AF)	95.24%
Period Hours (PH)	168	Unavailability Factor (UF)	4.76%
Available Hours (AH)	160.00	Reliability Factor (RF)	100.00%
Service Hours (SH)	160.00	Service Factor (SF)	95.24%
Reserve Shutdown Hours (RSH)	0	Forced Outage Factor (FOF)	0.00%
Unavailable Hours (UH)	8.00	Mean Time Between Failures (MTBF)	160.00
Planned Outage Hours (POH)	8		
Forced Outage Hours (FOH)	0.00		

KPI Asset: Line\_1\_Dryer\_Outfeed\_Conveyor

Name: Line\_1\_Dryer\_Outfeed\_Conveyor

Setup maintenance:  [Configure Schedule](#) (no maintenance scheduled)

KPI Calculations:

KPI Aspect: speed | KPI Variable: vibration | Service Indication threshold: 70 | Default state: RSH - Reserve Shutdown hours

## MindSphere

MindSphere is the cloud-based, open IoT operating system from Siemens that connects real things to the digital world, and enables powerful industry applications and digital services to drive business success. MindSphere is an open platform as a service (PaaS) system, which enables a rich partner ecosystem to develop and deliver new applications.

Siemens

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