

# Predictive maintenance implementation guide Tips on starting fast and small on condition monitoring

<Vol. 6> Starting small on your first step toward digital maintenance



# To the era of predictive maintenance

Maintenance in the manufacturing industry is increasingly shifting to predictive maintenance, driven by progress in digital technology and by environmental changes brought on in response to the COVID-19 crisis. Here we provide a general description of predictive maintenance and what is behind its increase in implementation.

## What is predictive maintenance?

Predictive maintenance is a new maintenance method in which equipment conditions are monitored in real time around the clock using monitoring devices, to identify and address failures before they occur. It is distinguished from the conventional preventive maintenance, in which equipment is maintained according to a set schedule.

### System configuration

#### Edge Computing

Abnormalities assessed on-site using measurement data

#### Cloud Computing

Abnormalities assessed by specialized system engineers who analyze equipment condition measurement data on the cloud

Predictive maintenance adopts one of the two kinds of system configurations described above, and various companies are starting to offer many different solutions. It makes eliminating downtime caused by sudden equipment failures occurring after scheduled inspections a realistic possibility. Predictive maintenance is also expected to reduce excessive part replacement costs incurred in preventive maintenance and to resolve labor shortage issues.

Predictive maintenance, if realized, has many advantages, but its implementation also comes with many issues. This document describes the mindset and steps required to resolve these issues, and also some of OMRON's predictive maintenance products and solutions.

## What predictive maintenance can accomplish

Predictive maintenance helps reduce failure response costs by capturing signs of failure in the machines manufacturers use for manufacturing, allowing them to predict failures and take proper measures.



Reduction of  
excess part  
replacement costs



Maintenance efficiency  
improvement with limited  
human resources  
Ability to create surplus time

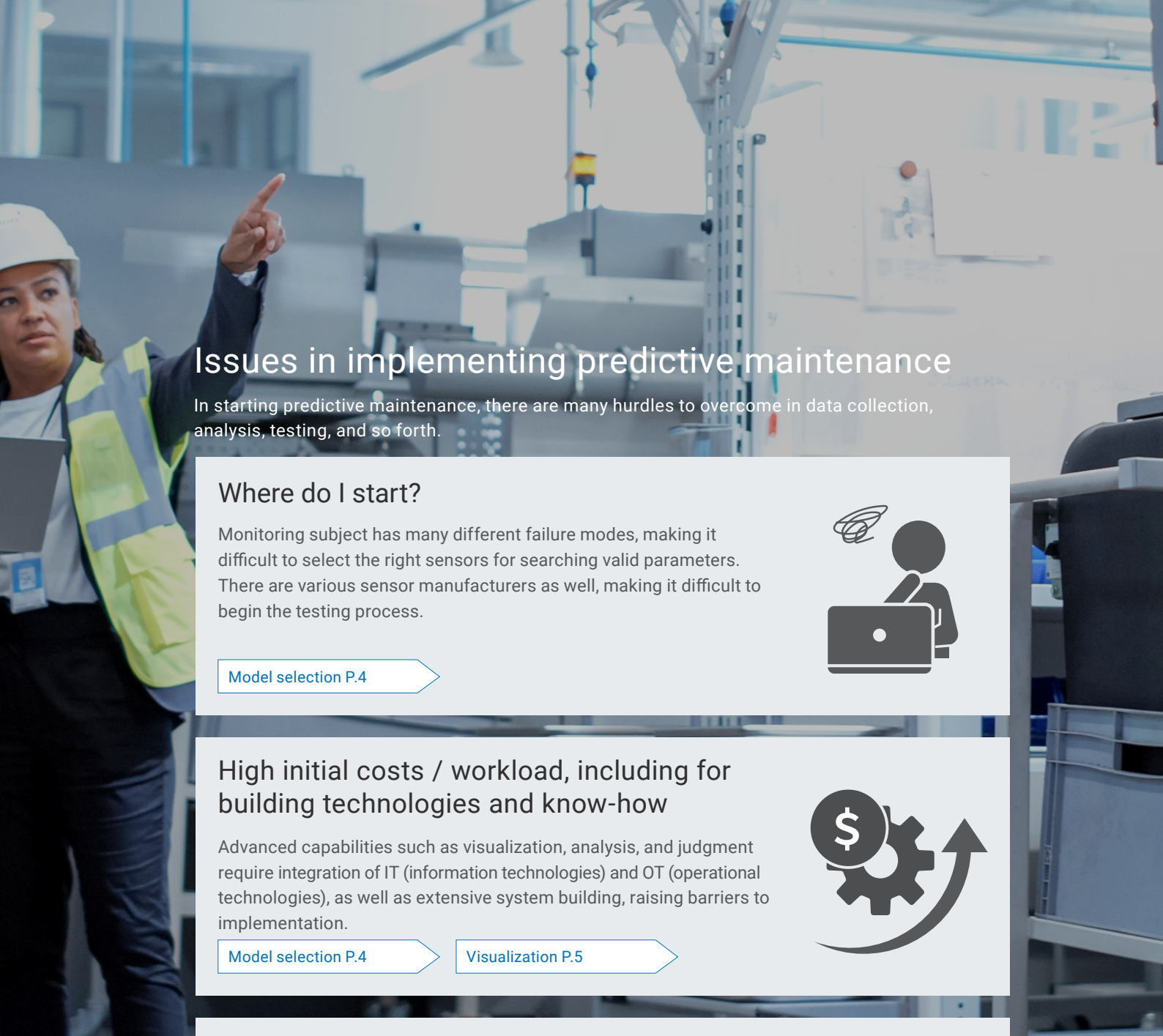


Reduction in  
risk of equipment  
downtime



Maintenance of skilled  
engineers even with little  
experience





# Issues in implementing predictive maintenance

In starting predictive maintenance, there are many hurdles to overcome in data collection, analysis, testing, and so forth.

## Where do I start?

Monitoring subject has many different failure modes, making it difficult to select the right sensors for searching valid parameters. There are various sensor manufacturers as well, making it difficult to begin the testing process.



[Model selection P.4](#)

## High initial costs / workload, including for building technologies and know-how

Advanced capabilities such as visualization, analysis, and judgment require integration of IT (information technologies) and OT (operational technologies), as well as extensive system building, raising barriers to implementation.



[Model selection P.4](#)

[Visualization P.5](#)

## No data connecting to failure

Causal relationships between collected data and failures are unclear. No failures occur during data collection period.



[Retrieving the right data P.5](#)

## Failures can be identified but not predicted

Failure prediction requires understanding of the mechanism leading up to failure, and logic for determining threshold values.

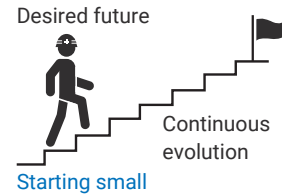


[Setting judgment criteria P.5](#)

# Starting small on predictive maintenance

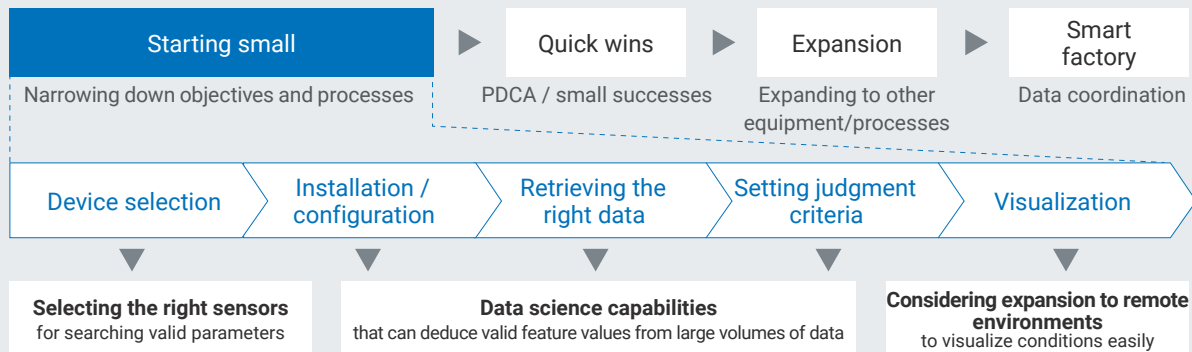
## Mindset required for predictive maintenance

To implement predictive maintenance, you need a mindset and system building process that allows you to start small and fast, and to proceed continuously and incrementally toward the future you wish to achieve.



### Steps to take

To start small on predictive maintenance and work toward a smart factory, you need to follow the following steps, from data collection to testing, and compare a wide range of data as you build your own system.



## OMRON lets you start small on predictive maintenance

Our condition monitoring device products enable data collection, analysis, and judgment on on-site devices, eliminating the need for system design and data analysis so that you can start small with little workload and low costs.

### Device selection

There are so many kinds of sensors-which ones from which manufacturers are right for us?

### Product lineup that exhaustively covers a wide range of monitoring subjects and failure modes

Start small and fast by selecting the right monitoring device for you based on what you wish to monitor and their failure modes.



Selecting the right OMRON condition monitoring device P.6-7 >

### Installation/configuration

Large-scale construction requires equipment stoppage, which is extremely disruptive

### Retrofitting existing equipment for predictive maintenance Configuration tool that minimizes system building effort

Our solutions let you start small and safe by retrofitting existing equipment with monitoring sensors. You can also start fast by minimizing implementation effort with our configuration tool.

Easy installation



Three-step configuration



Retrofitting existing equipment for predictive maintenance P.8 > Configuration tool for fast rollout P.9 >



### Retrieving the right data

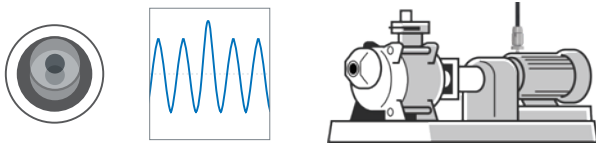
There's so much data collected, but which of it is connected to abnormalities?

## Helping select which data to retrieve based on failure modes to detect

Our solutions convert information collected by sensors into numerical values that are easy to understand and into parameters that reflect changes sensitively, which in turn can be compared against threshold values to help you determine whether maintenance is necessary.

Example (K7DD)

Motor rotating shaft : Impact



Momentary impact at the load converted to numerical values

Potential applications 1 and 2 P.10-13 >




### Setting judgment criteria

Lack of knowledge about predicting when it will reach the failure mode

## Identifying abnormalities based on selected feature data Helping set alarm thresholds based on verified data

Our solutions provide the most effective feature values, relevant threshold values, and other useful information for each failure mode based on knowledge accumulated through on-site investigation, so that you can start fast on your predictive maintenance journey.

### Example

Model	thresholds
Motor condition monitoring	Trigger setting, feature values, alarm thresholds
K7DD-PQ	You can download the application setting files for various abnormalities    Abnormality of rotary shaft    Cutting tool damage    Grease degradation
Comprehensive current diagnosis type	Degradation level
K6CM-C12	Degradation level1, 2 Warning +5% at max                      Critical +10% at max
Vibration & temperature monitoring type	Acceleration
K6CM-VB	Input the following data into the tool and calculate •shaft diameter of motors                      •Number of revolutions of motors
Insulation resistance monitoring	Insulation resistance
K7GE-MG	Warning 20.0M Ω                                      Critical 1.0M Ω
Heater Condition Monitoring	Heater degradation
K7TM-A2	Warning 3%    Critical 5%

Potential applications 1 and 2 P.10-13 >

### Visualization

Measures such as BI tool implementation can be cost-consuming

## Monitoring the conditions of a wide range of equipment without expensive BI tools

Analysis and judgment are carried out within condition monitoring devices, allowing for equal levels of visualization on-site and from the office. Because our solutions process data within condition monitoring devices, they can be applied to a wide range of equipment. They also enable continuous predictive maintenance activities at manufacturing sites that require rapid response to change.

On-site




Transistor output



EtherNet/IP Modbus



5678

Remote

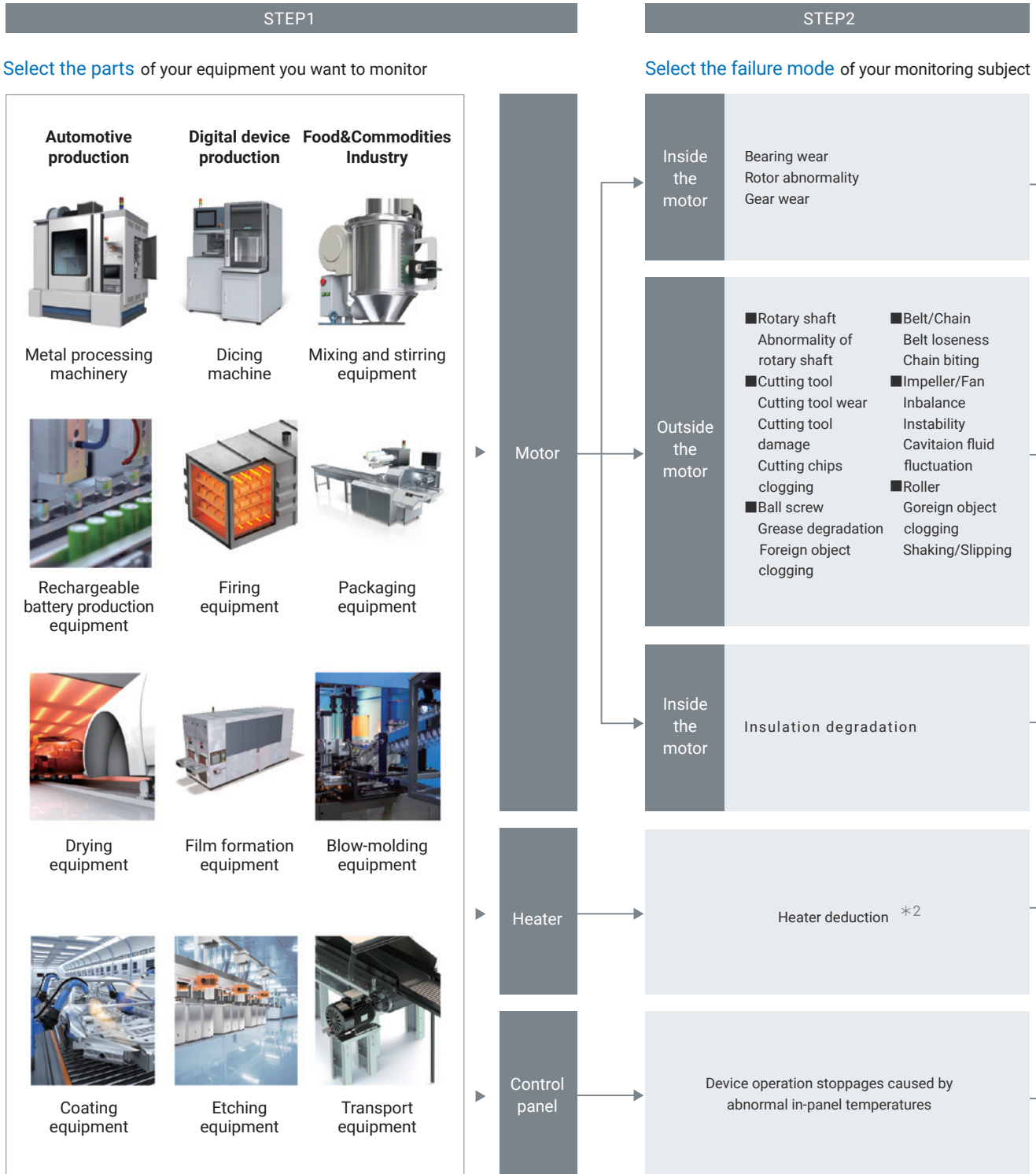


Remote

Data collection and visualization that only OMRON can deliver P.14 >

# Selecting the right OMRON condition monitoring device<sup>\*1</sup>

Our products allow you to easily select the condition monitoring devices you need to start small on your predictive maintenance journey, based on monitoring subject, failure mode, and equipment criteria.





STEP3

Select the criteria for your monitoring subject Example issues \*3

Uses AC servomotors or three-phase induction motors that frequently change speed



**Dicing machine**  
Reducing decline in cutting quality caused by cutting tool wear



**K7DD**  
Advanced motor condition monitoring device



Uses three-phase induction motors

Abnormalities cannot be detected through vibration



**Mixing and stirring equipment**  
Reducing quality defects caused by contamination inside mixer



**K6CM-CI**  
Motor condition monitoring device (Comprehensive current diagnosis type)



Abnormalities can be detected through vibration



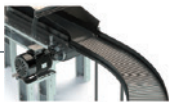
**Drying equipment**  
Reducing deterioration of in-furnace environment caused by fan operation stoppages



**K6CM-VB**  
Motor condition monitoring device (vibration & temperature monitoring type)



In continuous operation



**Transport equipment**  
Preventing line stoppages caused by short circuits



**K6CM-IS**  
Motor condition monitoring device (insulation resistance monitoring type)



Operation stopped regularly



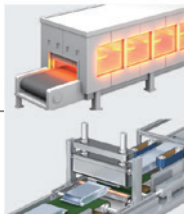
**Vacuum pump motor**  
Preventing equipment stoppages and short circuits caused by insulation degradation



**K7GE-MG**  
Insulation resistance monitoring device



Uses heaters with resistance heating elements



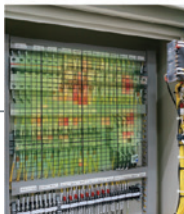
**Fring equipment/horizontal pillow packaging machines**  
Reducing quality defects and sealing abnormalities caused by heater burnout



**K7TM**  
Heater condition monitoring device



Temperature abnormalities may occur due to excessive temperature rise or loose screws



**In-panel devices**  
Preventing device operation stoppages caused by abnormal temperatures



**K6PM-TH**  
Thermal condition monitoring device



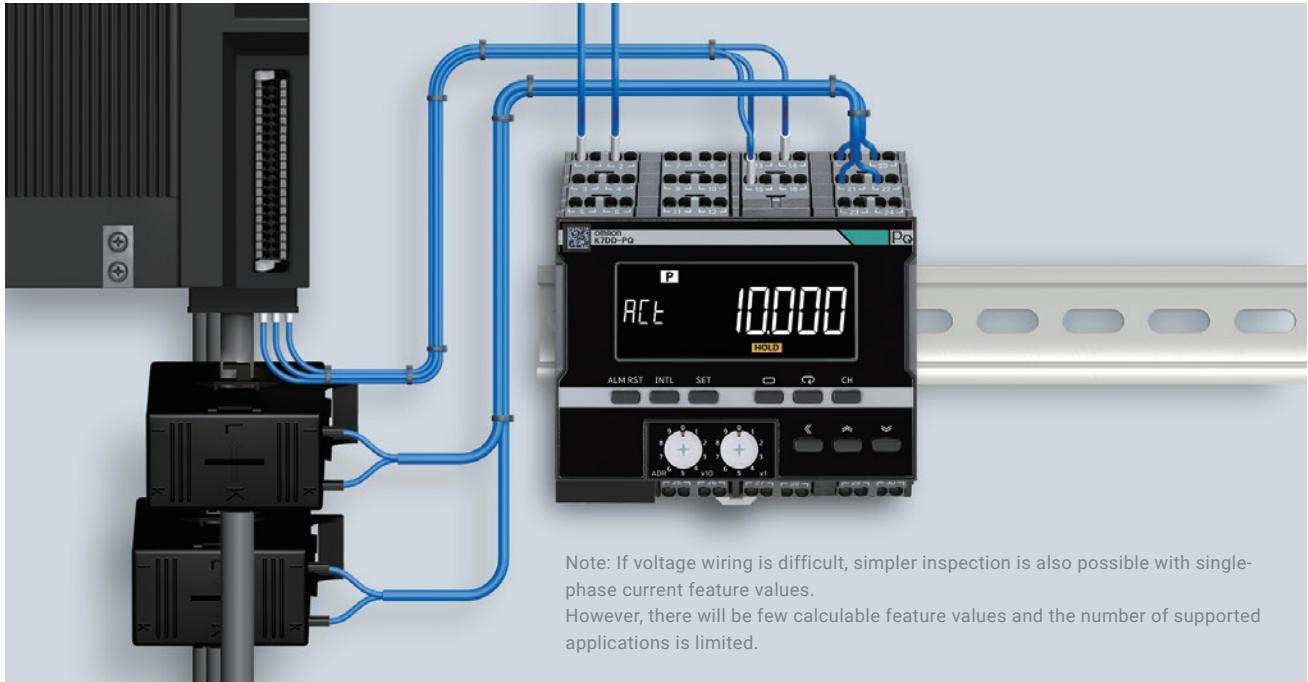
\*1. This chart is meant to serve as a rough reference for product selection. Please consult our sales staff on the failure modes and criteria of your equipment.

\*2. "Heater burnout" in this document refers to "burnout due to wire diameter reduction caused by oxidation-induced deterioration."

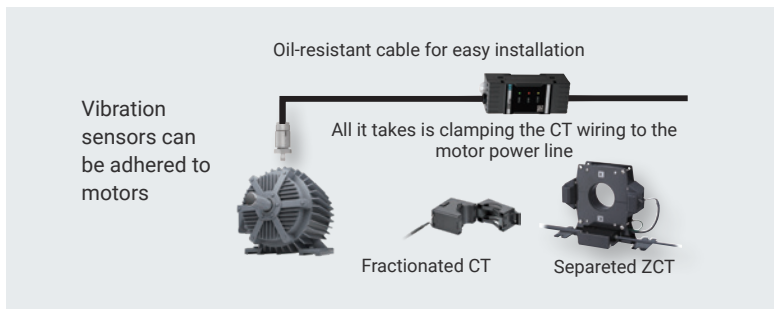
\*3. Issues listed in this chart are only some examples.

# Retrofitting existing equipment for predictive maintenance

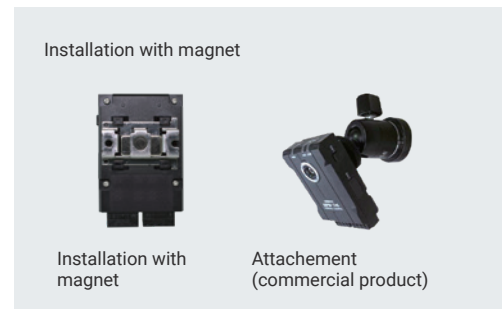
Our condition monitoring devices can be retrofitted to implement monitoring systems without the need for system design or for large-scale equipment remodeling or construction.



With motor condition monitoring devices



Vibration sensors can be adhered to motors



## Compact design built for control panels

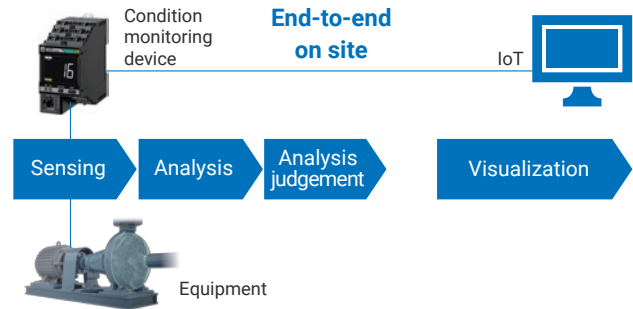
Compact size  
(45 (W) × 90 (H) × 90 (D) mm)  
enables in-panel mounting (K6CM)





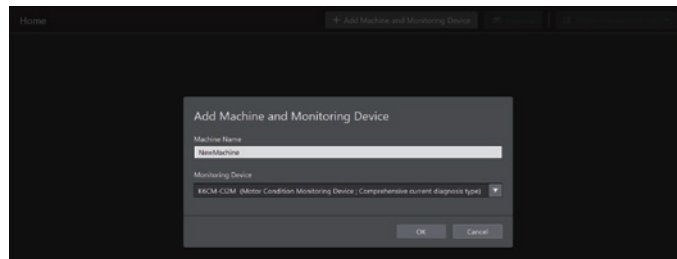
# Configuration tool for fast rollout

In predictive maintenance using cloud environments and PLCs, analysis is difficult and can be a technical barrier in post-implementation operation. Our condition monitoring devices allow for operation-from setting threshold values to equipment abnormality verification-to be completed within the manufacturing site with no advanced skills required, by delivering easy visualization of equipment conditions.



## Condition monitoring devices can be configured with a single tool

The Condition Monitoring Configuration Tool allows for batch configuration of a wide range of condition monitoring devices, such as those for monitoring motors, temperatures, insulation, and heaters. It can be used without any special skills, reducing training effort.



**K7DD**  
Advanced motor condition monitoring device



**K6CM-CI**  
Motor condition monitoring device (Comprehensive current diagnosis type)



**K7GE-MG**  
Insulation resistance monitoring device



**K7TM**  
Heater condition monitoring device

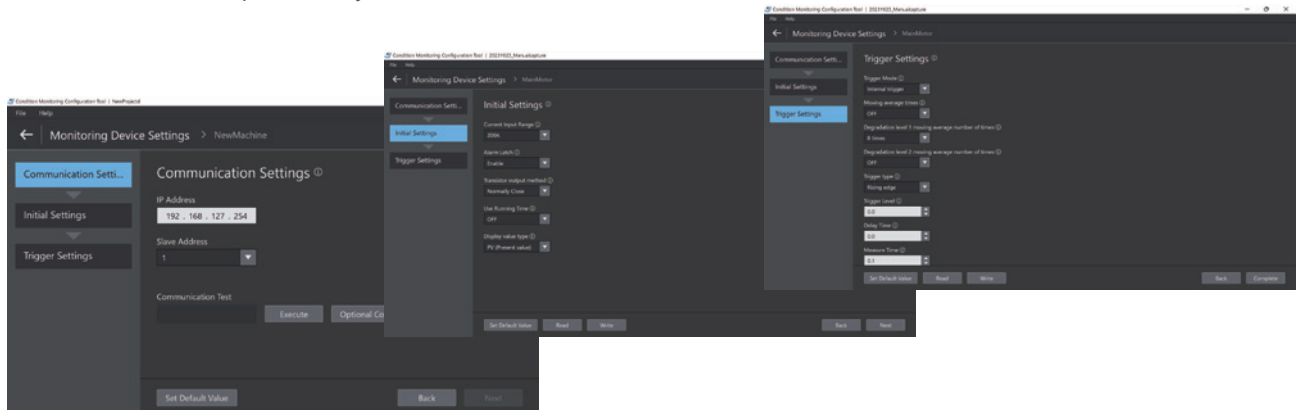


**K6PM-TH**  
Thermal condition monitoring device



## Easy three-step configuration

Setup can be completed in just three steps: communications setup, initial setup, and trigger setup.\*1 With its high operability, the tool boosts on-site productivity as well.



You can download the Condition Monitoring Configuration Tool from the URL below.  
[https://www.ia.omron.com/cmc\\_tool](https://www.ia.omron.com/cmc_tool)

\*1. Substitute "trigger setup" with "contact-free temperature sensor setup" for K6PM, and with "standard resistance value registration" for K7TM.

# Potential application 1

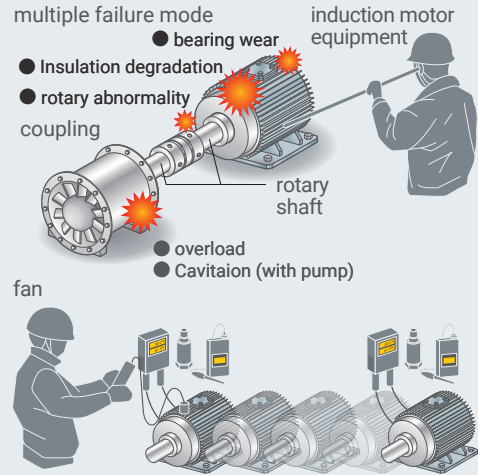
## Resolving issues in motor equipment inspection

### Issue Reducing the time required to patrol and inspect motors

- Maintenance personnel must inspect multiple items on multiple parts of the motor equipment according to its different failure modes, which is effort-consuming
- Although some equipment is subject to automated monitoring using vibration sensors and other devices, installing multiple sensors and per-motor monitoring is causing workload to balloon

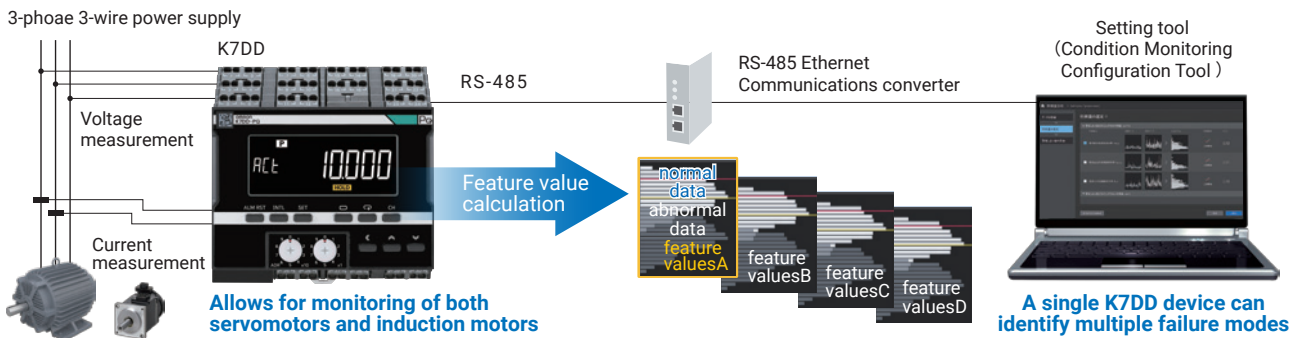
The time it takes to run through the extensive patrol checklist is also an issue

status \ event	Vibration	Heating	Electrical resistance decrease	Overcurrent
bearing wear	✓	✓		✓
Insulation degradation			✓	
overload	✓	✓		✓
open phase operation		✓		



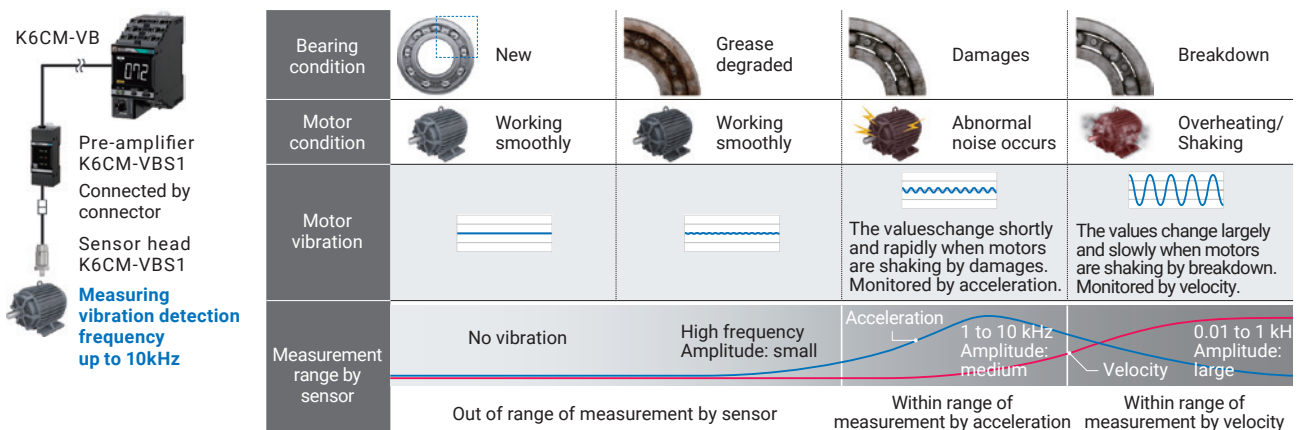
### K7DD Monitors failure modes of different motors in real time

K7DD calculates approximately 400 types of feature values from voltage and current measurements obtained via the power line of the motor's rotary mechanism. The feature values are sorted in order of validity, allowing you to immediately identify the values you need to look at, and to monitor motor conditions in real time.



### K6CM-VB Monitors bearing abnormalities through vibration and temperature

By constantly monitoring for vibrations, it can detect signs of abnormalities in bearings and the like as soon as possible. The surface temperature of the routinely inspected motor can be measured at the same time as vibrations.

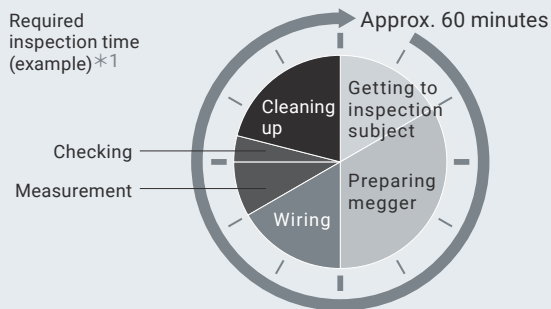




**Issue**

## Increasing inspection frequency to prevent insulation deterioration, which is difficult

- Although more frequent inspections are needed to keep up with the speed of insulation deterioration, inspections take too much time.
- The number of inspection subjects is too large for inspections to be conducted more frequently; maintenance must be streamlined to reduce inspection workload



Getting to inspection subject



**K7GE-MG**

## Reduces inspection burden through automated insulation resistance measurement

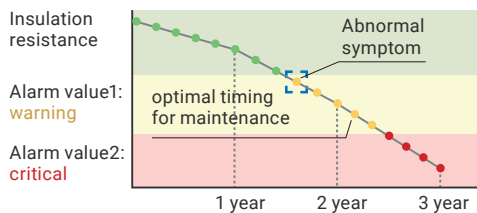
K7GE enables more frequent measurement by automating motor insulation resistance inspection and delivering highly reproducible measurement. Measurement data can be collected and analyzed by remote as well, using tools and other means. K7GE also monitors insulation deterioration trends, allowing for efficient maintenance.

### Inspection time reduced to just 2 minutes through automation

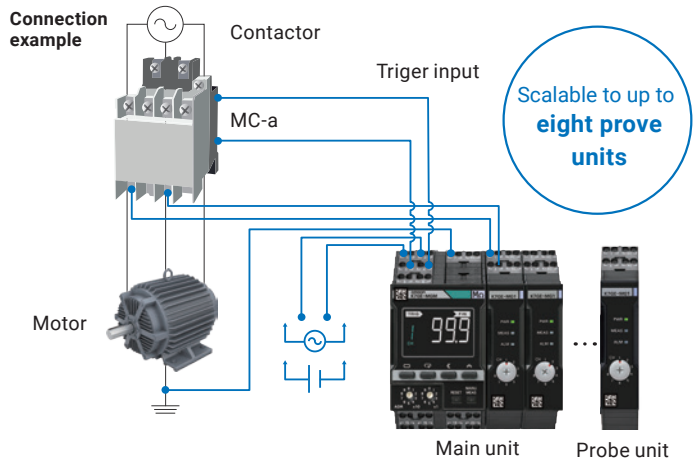


\*1. Inspection task improvement case at OMRON's own factory

### optimal timing for maintenance



### Easy to install and retrofit



Note: Main unit and probe unit connected using connector; no tools required

## See the below products for motor equipment condition monitoring

**K7DD**  
Advanced motor condition monitoring device



For more information



**K6CM-VB**  
Motor condition monitoring device (vibration & temperature monitoring type)



For more information



**K7GE-MG**  
Insulation resistance monitoring device



For more information



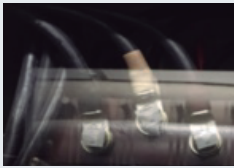
# Potential application 2

## Resolving issues in heater equipment inspection

### Issue

There are limits to what thermographic imaging can accomplish in in-panel device temperature inspection

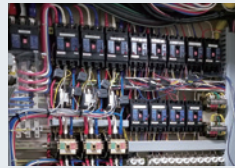
- Parts of the wiring prone to heating and device temperatures are regularly inspected using thermographic imaging, which can only measure a limited range at a time; using this method to measure the entire panel requires significant effort
- Antiquated facilities must be inspected more frequently and in more detail (more parts to inspect), which is difficult for personnel busy with other maintenance tasks



Abnormal heating of wiring caused by loose screws



Abnormal heating of transformers caused by rise in ambient temperatures



Overheating of devices caused by rise in in-panel temperatures

Lower inspection frequency can lead to...

Higher risk of fire/smoke

Number of fires at work/factory sites at factories, etc. (2017-2019)  
**2,751** \*1

**34%** of fire sources were electrical



\*1. Kyoichi Kobayashi 「工場火災の実態とその対策～工場火災に備えて管理監督者が知っておくべきこと～」  
<URL:https://gcoe.tus-fire.com/archive\_cms/kobayashi-k/> (in Japanese) issued in November, 2021.  
Page 2 accessed on the 19th of December, 2022.

### K6PM-TH

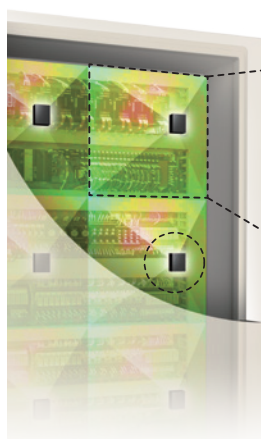
## Reduces inspection burden through automated measurement of in-panel temperatures

The contact-free temperature sensor (specialized thermal imaging sensor) K6PM-THS delivers constant automated measurement of temperature changes inside a panel while it is in operation, with its door kept closed.

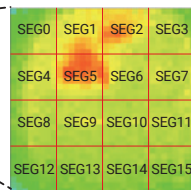
The main unit K6PM-THMD, installed inside the panel, conducts automated analysis of temperature data to identify abnormal devices.

Constant measurement of temperatures across in-panel environment

Identification of abnormal devices through automated analysis

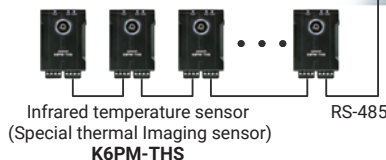


Identifying an abnormal device by segmenting the thermal image.



Threshold can be set to each segment of a 16-split thermal image

Up to 31 K6PM-THS sensors can be connected with a main unit.



Three-step indication for the temperature status  
Enables on-site checks on temperature conditions

normal Cautions Warning



EtherNet/IF

Modbus

Condition Monitoring Configuration Tool (configuration tool)  
Enables remote monitoring of temperature conditions



## See the below products for temperature condition monitoring

K6PM-TH  
Thermal condition monitoring device

Infrared thermal sensor (Special thermal imaging sensor) K6PM-THS



Main unit K6PM-THMD

For more information



Issue

## Preventing heater burnout, which causes significant loss due to waste

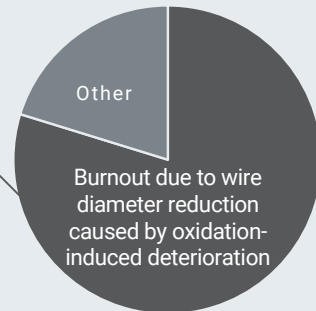
- Heater burnout can cause sudden furnace stoppage, which leads to a massive loss of products in the process of manufacturing due to disposal or repair
- With material costs skyrocketing, reducing loss due to waste is an urgent issue

Causes of sheath heater (industrial heater) failure \*1

**80% caused by heater burnout**

Other causes

Disconnection in terminal parts (standoffs, etc.) / short circuit caused by insulation deterioration of insulation material / corrosion

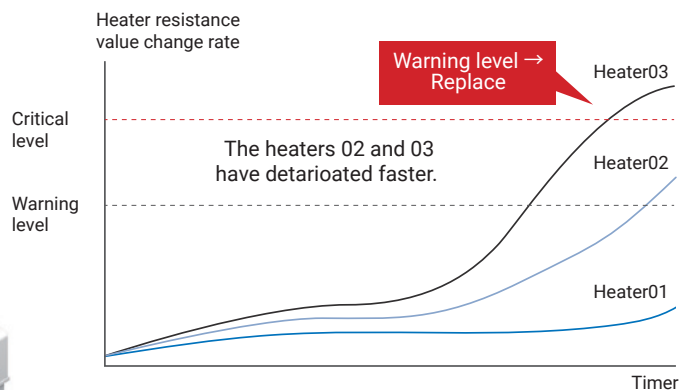
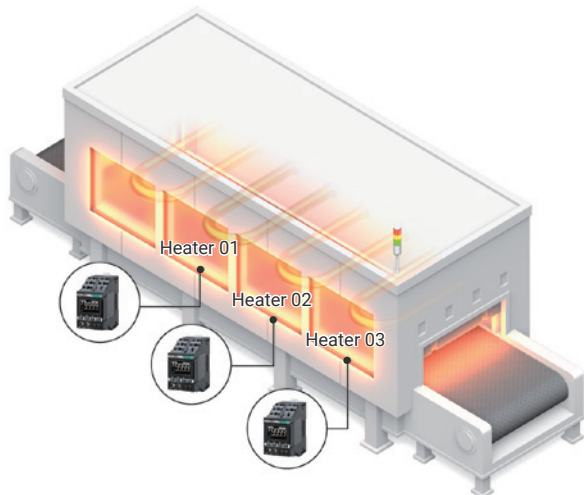


\*1. According to investigation by OMRON, as of July 2022.

K7TM

## Prevents burnout by visualizing deterioration trends in heater equipment

K7TM keeps track of the state of deterioration of each heater by monitoring equipment heater conditions through heater resistance values. It allows you to replace heaters according to degree of deterioration, preventing heater burnout and reducing waste due to loss.



See the below products for heater equipment condition monitoring

K7TM  
Heater condition  
monitoring device



For more  
information





# Data collection, visualization and utilization that only OMRON can deliver


Enables easy implementation of simple and freely scalable remote monitoring systems

Our condition monitoring devices support communication protocols including Modbus RTU, through which they communicate the assessment/judgment results garnered from their analysis to higher-level systems. They allow for flexible systems that can cater to a broad range of environments, from predictive maintenance of stand-alone equipment and facilities to that of entire production lines through centralized remote monitoring from office PCs. We also offer monitoring tools, analysis tools, and PLC connection programs necessary for remote monitoring, to enable the optimal implementation according to the level of predictive maintenance improvement/innovation.


	Necessary components	Monitoring method	Level of remote maintenance innovation	
Office	EtherNet/IP® Modbus	Centralized monitoring using monitoring system 	Deployable simple remote monitoring	Expansion Small Start
Manufacturing site	HUB PLC Transistor output	Signal lights HMI On-site PC 	Condition monitoring system that can be easily built solely by onsite members	
	Condition monitoring device Power HUB Temperature Motor	 Status normal (Green)   Failure warning (Yellow)   Failure critical (Red) Conditions visualized through values displayed on component LCD and alert bar color (red/yellow/green)	Easy stand-alone implementation	

## Solution combining equipment deterioration monitoring with power consumption monitoring

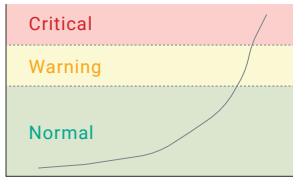
We propose a solution that enables monitoring of the correlation between equipment deterioration and power consumption by combining a condition monitoring device with a power volume monitor. These devices can comprehensively monitor equipment and sort out the change of equipment utilization rate and abnormality, which enables monitoring correctly.



**EQ100-E Sensor Network Server**  
Data hub synchronizing and collecting obtained data. Program-less for immediate connection and visualization.




**K7TM Heater Condition Monitoring Device**  
Heater monitoring in drying furnace process enables systematic maintenance to prevent heater burnout causing line interruption or quality inconsistencies




Trends toward deterioration of heater

Critical level  
Warning level  
Normal

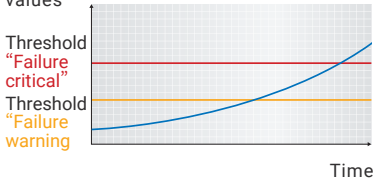
Time



**EQS-AD10-E EQ-ANDON**  
Visualizing equipment deterioration and power status enables comprehensive monitoring of the correlation between equipment deterioration and power consumption, which can be connected to actions aimed at energy saving.




**K7DD Advanced Motor Condition Monitoring Device**  
Display the monitoring motor condition by color, green, yellow and red. Winder monitoring in drying furnace process enables systematic maintenance to prevent line interruption due to motor shutdown



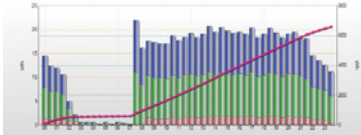
Feature values

Threshold "Failure critical"  
Threshold "Failure warning"

Time



**KM-N2 Power Monitors**  
Visualization of power in drying furnace process enables energy saving activities and initiatives to improve energy productivity





# Utilizing manufacturing floor data and solving challenges in collaboration with the customer

Based on ideal visions and actual situations of a factory, we pursue manufacturing floor evolution through data utilization in concert with the customer. Working together with you, we identify and examine the intrinsic issues associated with business management challenges. And we strive to continue innovating your manufacturing floor by merging your know-how & experience with OMRON's unique know-how, technology & products, and through collaborations with partner companies.

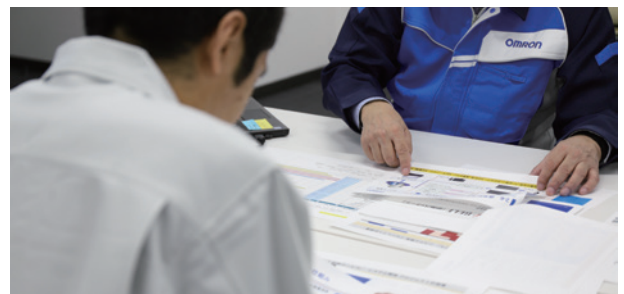


## Helping customers attain flexible, people-friendly production adept in a quick response to changes

Conducting hearings on visions for the ideal factory, we find enhancements and improvements based on manufacturing floor data, and provide tailor-made guidance with effective scenarios to each customer.

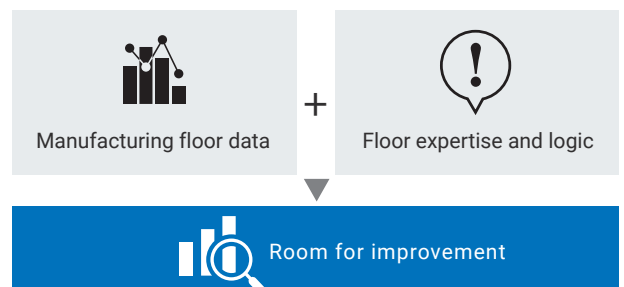
### Co-creation working closely with you

Setting the project goal through discussions, we collaboratively work with you for a resolution of the challenges based on manufacturing floor data.



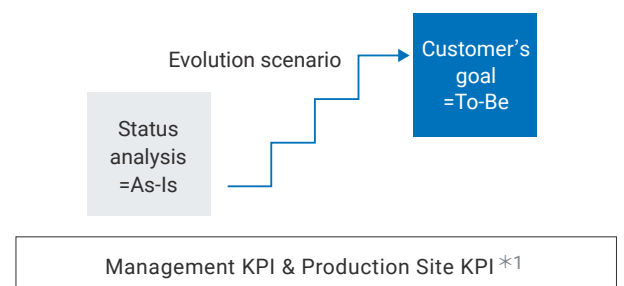
### Formulation of challenges based on data

From a bird's-eye view of production equipment and elements based on an actual object/place/situation, we quantify the room for improvements through a logical & scientific approach.



### Firm advancement of innovations in phases

After recognition of a scenario for attaining the goal with you, we provide assistance through a multi-stage approach for floor innovation that ensures results.



\*1. Key performance indicator

# Monitoring the condition of critical equipment in a production environment

Advanced Motor Condition Monitoring Device  
K7DD



Catalog download

Cat. No.N235-E1

Motor Condition Monitoring Device  
K6CM Series



Catalog download

Cat. No.N220-E1

Insulation Resistance Monitoring Device  
K7GE



Catalog download

Cat. No.N226-E1

Heater Condition Monitoring Device  
K7TM



Catalog download

Cat. No.N229-E1

Thermal Condition Monitoring Device  
K6PM



Catalog download

Cat. No.H232-E1

## Application Guide for Predictive Maintenance Solutions

for  
Automotive  
production



Cat. No.N237-E1

for  
Digital device  
production



Cat. No.N236-E1

for Food &  
Commodities  
Industry



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