

# M<sup>3</sup> Innovation

Strategy to take advantage of the IoT

Measure  
M2M  
Manage

2020-2021

The strategy to utilize IoT for improving production efficiency as well as quality.

**Mitutoyo**

**Measure**  
**M2M**  
**Manage**

**Strategy to take advantage of the IoT**  
The strategy to utilize IoT for improving production efficiency as well as quality.

Mitutoyo's concept  
**M<sup>3</sup> Innovation**



**Measure: measuring precisely**  
**M2M: machine-to-machine connection**  
**Manage: managing measurement data & measuring machine**

Mitutoyo group suggests innovation utilizing IoT  
for smart manufacturing through three "M"s.

## Measure

•

Overturn the tradition that measurement must be performed in laboratories.  
“Manufacturing” and “Measuring” will become much closer.

CONCEPT  
**01**

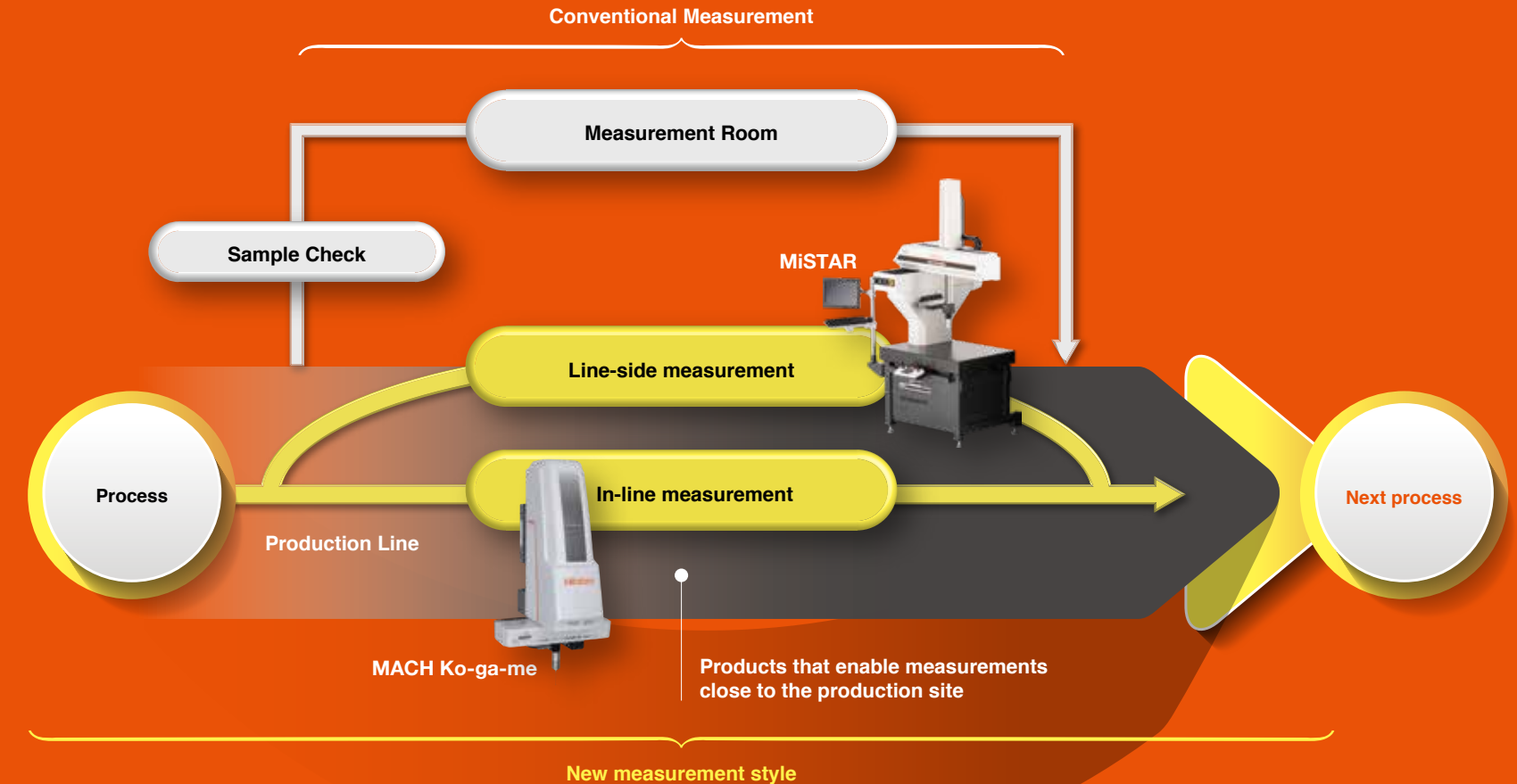
Even closer to the production line; right by the machine.  
New measurement style in the IoT era.

New measurement style in the automation era

Randomly select a product from the production line and move it to the laboratory. This process is always problematic for conventional off-line inspection aimed at improving production processes. Accordingly, Mitutoyo has developed measuring instruments that can be installed and used in the production workshop. These instruments enable in-line or line-side inspection without moving product to a laboratory. Much faster and accurate manufacturing. Mitutoyo contributes to achieve this through marketing our precision measuring instruments.

## Streamlining measurement

Installing a measuring instrument on a production line or line-side eliminates the work of moving selected products to laboratories and optimizes and accelerates production processes.



SMART FACTORY X MITUTOYO SYSTEM

## M2M



Go beyond borders and seamlessly utilize measurement data.  
Mitutoyo opens new horizons in the IoT era.

CONCEPT  
**02**

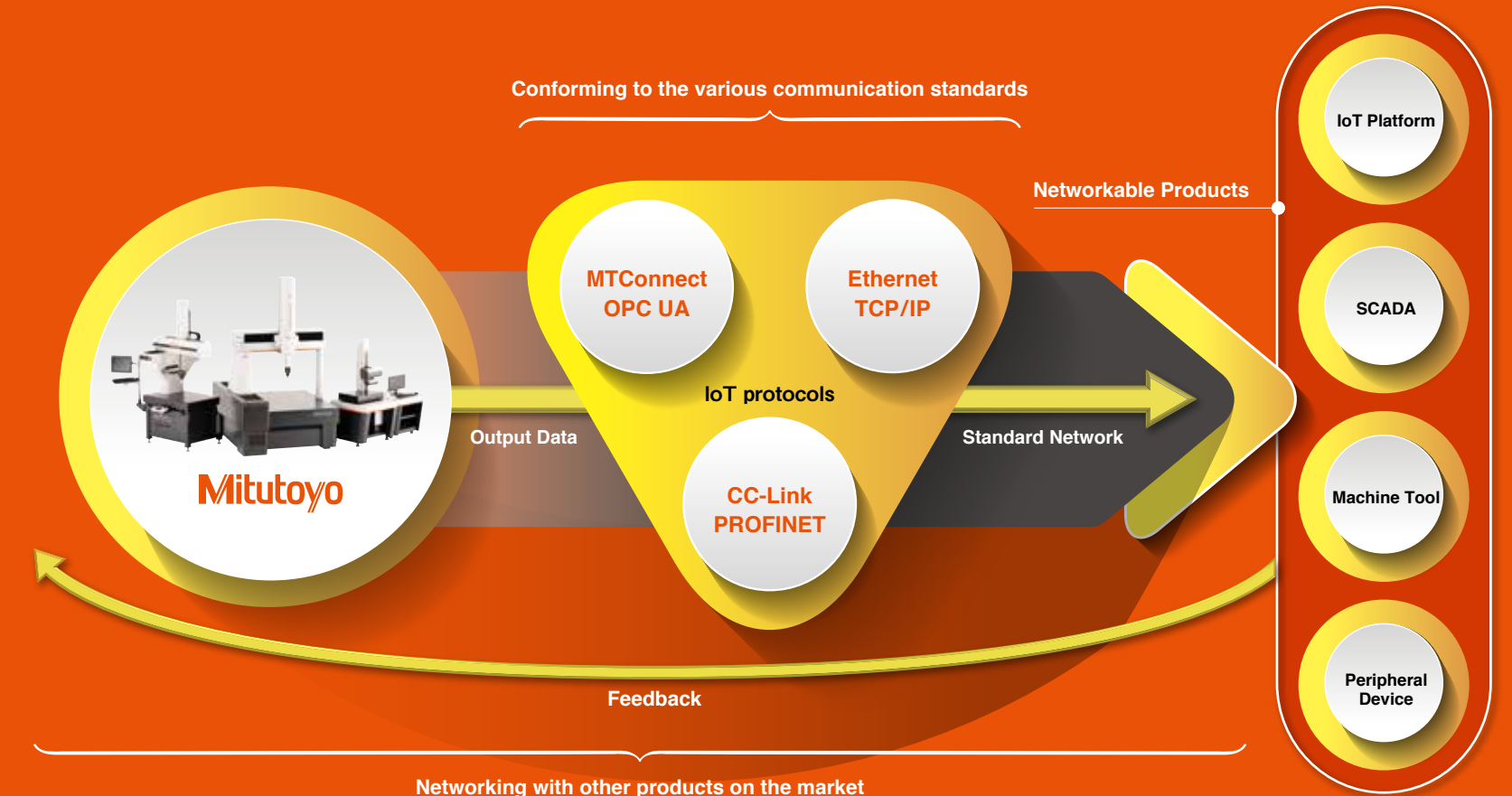
Go beyond the borders of standards and manufacturers to create  
diverse collaborations. User-centric smart manufacturing is right there.

Measurement beyond conventional border

The M2M (machine-to-machine) concept is that all machines are able to exchange information  
between them through a network and perform high-level processing and control.  
Mitutoyo is developing a network structure connecting all machines on production lines with measuring machines.

## Networking machine tools and peripherals

Remove barriers of differing machine specifications and  
communication protocols to achieve a user-centric management system.



SMART FACTORY X MITUTOYO SYSTEM

## Manage

Collected data will visualize  
the production status in real-time and even predictive.

CONCEPT  
**03**

From status management to predictive maintenance.  
The Smart Factory begins with visualization.

Smart factory by visualization of data

Mitutoyo has realized integrated management of production process information through a network. MeasurLink predicts defective product occurrence by collecting and analyzing measuring machine data in real time. The Status Monitor (SMS: Smart Measuring System) that displays the operation status of the measuring machine and the Condition Monitor that displays the condition of the measuring machine itself boost maintaining measurement accuracy and improve productivity and maintenance management.

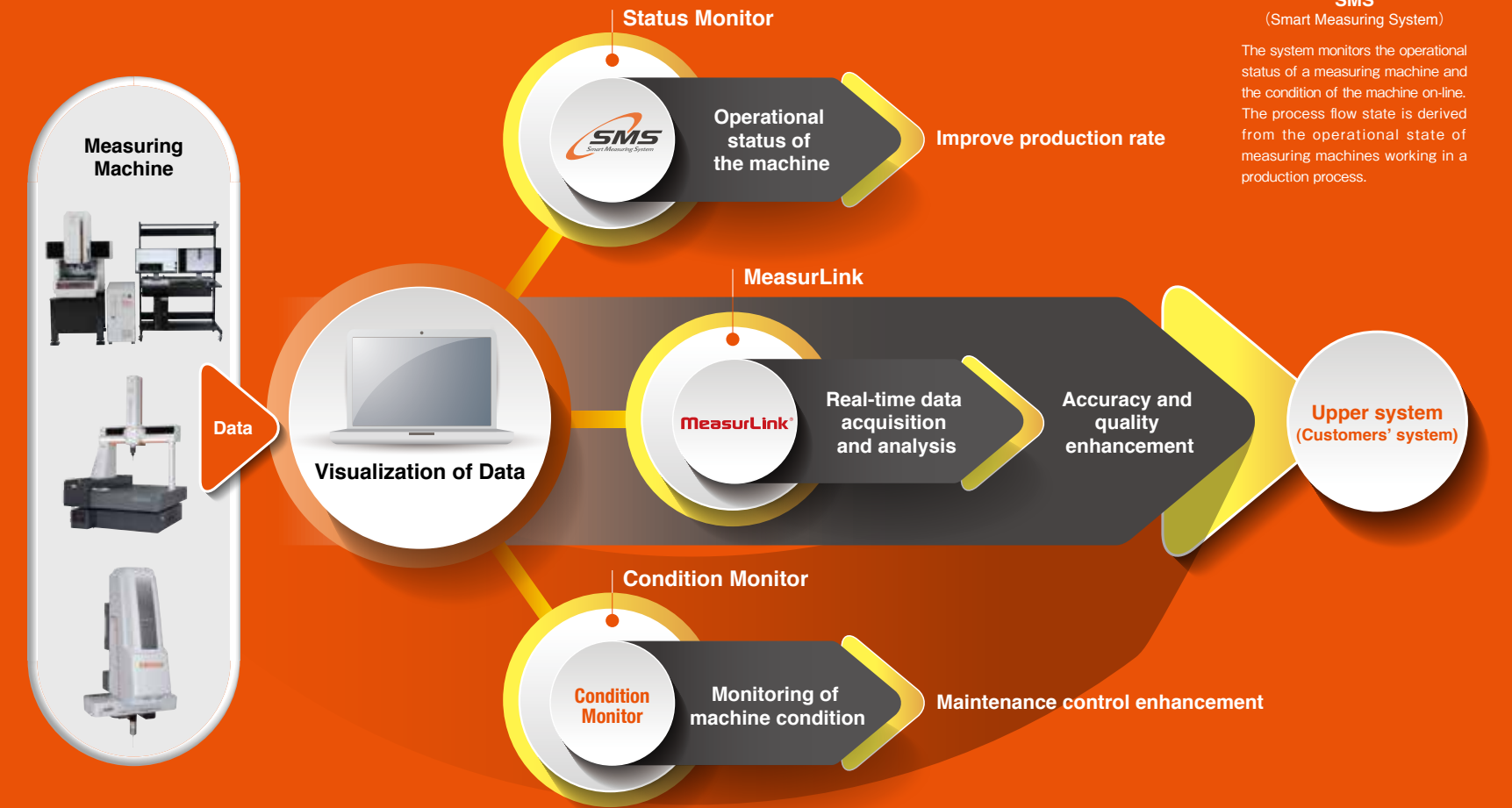
## Utilizing measurement data

Visualization by monitoring data collected from measuring machines.  
In addition, integrated management enables effective quality improvement of production processes.



SMS  
(Smart Measuring System)

The system monitors the operational status of a measuring machine and the condition of the machine on-line. The process flow state is derived from the operational state of measuring machines working in a production process.



SMART FACTORY X MITUTOYO SYSTEM



# M<sup>3</sup> Solution Center UTSUNOMIYA

**A new Solution Center has opened,  
integrating a plant and showroom.**

Utsunomiya Operations is our largest production site.

In 2020, a three-story building constructed as part of the master plan (redevelopment project) of the Operations was opened as the M<sup>3</sup> Solution Center UTSUNOMIYA, with our largest showroom anywhere in the world spread out across the first and second floors.

In the center, taking full advantage of having our own manufacturing environment, we display our most advanced products, technologies and solutions showcasing our future vision.

See how Utsunomiya Operations is working on new challenges and approaching future objectives.





# Combining technologies and ideas to transform the manufacturing environment

## Mitutoyo Utsunomiya Operations

Establishing a global reputation of the “Utsunomiya model”

Interview to General Manager Utsunomiya Operations



Director & Senior Executive Director  
General Manager of Utsunomiya Operations

**Takafumi Kano**

### Utsunomiya Operations’ master plan

The Utsunomiya Operations have two sites with three plants: a site of 105,507 m<sup>2</sup> (in the Shimoguri area) with the Small Tool Plant and Microcord Plant, and another area of 33,725 m<sup>2</sup> with the Kiyohara Plant. Redevelopment across the two sites began in 2018 and the new Solution Center that has been built in the Shimoguri area is considered the most important project in the first period of the master plan. Kano, General Manager of Utsunomiya Operations, says: “As a feature of this M<sup>3</sup> Solution Center, we focused on the concept of ‘a showroom beside the plant’.

How can our measurement technologies help customers solve their problems on-site? The center is a place for visitors to see our manufacturing activities and take insights back to their office for further consideration.”

### Value to production brought by measurement technologies

In addition to displayed measuring machines, visitors can see the production processes and calibration activities (in the Calibration Laboratories) while walking through the plant, enabling them to learn about practical measurement solutions. The center can provide a presentation involving both the plant and showroom.

The M<sup>3</sup> Solution Center at Utsunomiya Operations displays a large coordinate measuring machine that is not displayed at any other domestic site and also features the “Concept Zone” for proposing various solutions to production processes such as field measurement, automation, non-contact measurement, and data management. Measurement systems linked with robots and automated guided vehicles which always catch visitors’ attention. “In typical exhibitions, machines are displayed independently. At this center, however, the focus is on systems that are integrated into the lines connected with

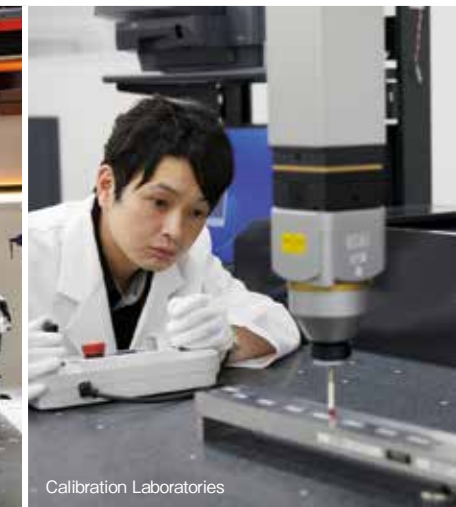
processing. We would like visitors to see that measuring machines previously only used in laboratories are now dynamically integrated into the production processes and are playing a primary role.”

### Utsunomiya as a byword for quality

Since its opening in June 2020, the M<sup>3</sup> Solution Center UTSUNOMIYA has had to limit the number of visitors due to the coronavirus pandemic. Although it will need some more time to start full operation, the staff are already seeing positive results. “Our strength is our ability to show both the products and the places where they are produced. Visitors often get excited to see the production processes and are impressed by our way of manufacturing.” The master plan of Utsunomiya Operations goes as far as the third period. Now the assembly plant is being constructed as part of the second period plan.

“In the future, Utsunomiya models produced by the Small Tool Plant, the Microcord Plant and the Kiyohara Plant may become a byword for a high level of precision measurement. To achieve that goal, we will continue working toward an unparalleled level of manufacturing,” Kano explains.

Mitutoyo Utsunomiya Operations is a source of “made in Japan” quality that can be delivered to plants all over the world. The Solution Center plays an important leading role in this.



Calibration Laboratories





# Venturing into field measurement in the IoT era

## Mitutoyo Utsunomiya Operations

Traceable production processes implemented in our own plant

### Interview with the General Manager

Utsunomiya Operations  
General Manager, Production Engineering Department, Microcord Plant

**Mitsuyoshi Sakuma**

### Going beyond product inspection to data utilization

The Microcord Plant at Utsunomiya Operations is dedicated to the production of coordinate measuring machines. In June 2020, the plant introduced MiSTAR 555, a booth-type system that is operable under typical air-conditioned temperatures during the production of driving components for CNC coordinate measuring machines. The system is operated in the production environment and also for field demonstration of a trial to verify the effect of line-side measurement. For hole positions of processed parts, a dedicated gage was used to inspect deviation from an allowable limit. In place of the gage, MiSTAR 555 is now used in dimension measurement during quality inspection. Sakuma, of the Production Engineering Department, says: "CNC coordinate measuring machines, as shown by their name, can quantify three-dimensional shape details (X, Y and Z). Products that passed the gage inspection still have small

characteristic differences depending on the machine tools, jigs and tools used, as well as the workers. The trends of such characteristics can be obtained as data and visualized by CNC CMM. I believe that knowing the current needs of production sites is essential to improving the process design level."

Data measured by MiSTAR 555 is collected and stored in MeasurLink, Mitutoyo's measurement data network system. Thus, the entire history of produced workpieces can be stored, ensuring traceability of the processes. Furthermore, finding the trends of the stored data by analyzing them can help improve the process capabilities and preventive maintenance of the processing lines.

### Easy integration into the existing environment

This measurement system has been integrated into the existing processing and inspection lines. To make it successful, it was important to maximize the use of

the existing installation environment and process flow.

"MiSTAR 555 is not air-driven and therefore has no pneumatic piping. All necessary controllers are housed in the installation platform, which can reduce the footprint by approximately 30 % compared with a typical bridge coordinate measuring machine and enables flexible layout according to the installation environment. The internally developed absolute scale requires no start-up operation. Adding the interface for connection to external devices, completing the system introduction was an effortless procedure", Sakuma recalls.

In the measurement system, flexible changeover according to day-to-day production is possible by reserving changeover during on-going inspection. In addition, the cantilever structure allows for both manual and automatic feeding and ejection. Such flexibility allowing for customization by users is one of the advantages of the system. Insights that may lead to a more effective production environment will be fed back to the

development team to contribute to future products.

### Expanding the use of field measurement

Unlike measuring machines for laboratory use, MiSTAR 555 is designed for on-site measurement by field workers. Sakuma is seeing a change in the mindset of field workers brought about by the introduction of the machine. "Not only production engineers like me but also field workers will feel uneasy if values are unstable. They will naturally wonder about the reasons and try to devise ideas to eliminate any instability." There are also plans for promotion and advancement toward a measurement system with more features, including geometrical tolerance measurement. Field measurement in the IoT era will continue to evolve in the future.



Line-side measurement system introduced in the Microcord Plant



Components of the coordinate measuring machine are prepared at this stage. They are automatically processed by multiple machining tools and then deburred and cleaned by workers.



A set workpiece is automatically transferred to the measuring machine as scheduled. Workers are released after setting the workpiece and do not have to wait during measurement.



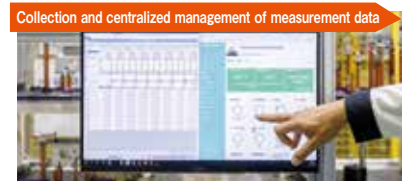
Workers measure workpieces with a dedicated gage to check whether their dimensions are correct as specified in the drawing.



Coordinate measurement is performed with MiSTAR 555. Shape details that cannot be measured with a gage will be quantified.



Workers set a workpiece in the jig on the measurement system at the right time. Each workpiece is identified by its QR code.



Measurement values are collected in real-time through MeasurLink and Condition Monitor and are displayed in the dashboard. This facilitates operation by field workers.



# Mitutoyo Recommend

A strategy to take advantage of the IoT

Mitutoyo's precision measuring machines to realize a Smart Factory

PRODUCT

01



Conduct coordinate measuring right next to the machine tool

Shop-floor Type CNC Coordinate Measuring Machine

**MiSTAR 555**

Incorporating environmentally friendly specifications and now more than two times resistant to staining than our conventional models. Accuracy is guaranteed over the wide temperature range of 10 to 40 °C, ensuring that this coordinate measuring machine can be used with confidence directly on the production line. The cantilever structure enables space saving of around 30 % compared to existing portal coordinate measuring machines.

Winner of the FY2019 Good Design Award.

PRODUCT

02



High-level pursuit of precision and speed

CNC Coordinate Measuring Machine

**Microcord CRISTA-Apex V Series**

Based on the keywords of "improved productivity" and "visualization", the product lineup covers a wide range of measurement applications, from small- to mid-sized workpieces. Offering high accuracy (1.7 μm in the initial accuracy specification term) as well as high speed and acceleration, the machine is equipped with an active scanning function to tolerate disparities between measured and design values.

PRODUCT

03



Delivering both high speed and high accuracy

High Accuracy CNC Coordinate Measuring Machine  
**STRATO-Apex Series**

This machine can provide high-precision measurement, high-speed and accelerated driving at the same time. For this, the main body and guide structures have been redesigned to achieve high rigidity. For position detection, an ultra-high-precision length measuring unit (internally developed) has been adopted to deliver extremely accurate position detection and control of this ultra-high-precision machine.

PRODUCT

04



Ultra-high-precision machine delivering one of the highest levels of precision in the world

Ultra-high Accuracy CNC Coordinate Measuring Machine  
**LEGEX Series**

This machine's "structure with a fixed bridge and movable table" has the ram (Z axis) for vertical travel that is mounted on the carriage, the carriage (X axis) for horizontal travel along the bridge firmly connected to the base, and the table (Y axis) for horizontal travel on the base. This machine has adopted various technologies including the external vibration control, internal vibration control, and high-precision glass scale with an expansion coefficient of 0, all of which enable complete analysis and removal of error causes, delivering one of the highest levels of precision in the world.

PRODUCT

05



High acceleration and high speed for high throughput

In-line Type CNC Coordinate Measuring Machine  
**MACH-V**

This vertical CNC coordinate measuring machine is suitable for measuring vertical machining. It makes it possible to build a flexible measuring system to replace gage measurement in power train production lines. It also delivers high acceleration and travel speed, enabling high throughput measurement. Accuracy is guaranteed within a temperature range of 5 to 35 °C.

PRODUCT

06



In-line, horizontal machine with high-speed drive

In-line Type CNC Coordinate Measuring Machine  
**MACH-3A**

This horizontal CNC coordinate measuring machine is suitable for measuring workpieces that require measuring on multiple sides. A workpiece is mounted on the rotary table and sequentially rotated to the best orientation for each series of measurements. With best-in-class CNC operation, acceleration and measuring speeds, amazing throughput is achieved. Pursuing space saving and improved durability on production lines, the machine guarantees accuracy under an extensive temperature environment from 5 to 40 °C.



PRODUCT

07



Can be installed outside the inspection room

In-line Type CNC Coordinate Measuring Machine  
**MACH Ko-ga-me**

Designed to be operational 24 hours a day and can be installed on a production line. In addition to measuring small workpieces by itself, a measurement system for large workpieces can be configured by using the moving axis unit. Designed to be lightweight and compact, various types of probe can be mounted.

PRODUCT

08



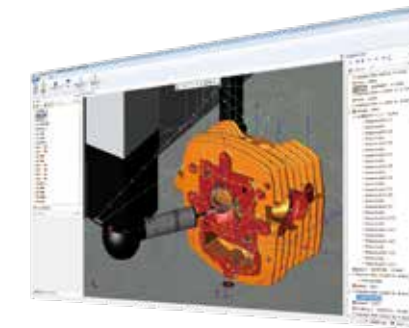
Perfect for measuring gear profiles

Gear Measurement and Evaluation Software for CNC Coordinate Measuring Machines  
**GEARPAK Express**

A 3D CAD model is created from gear specifications that can be input in an intuitive manner. The model enables workers to easily visually check whether measurement will be performed as intended. Automatic program creation and on-screen measurement guidance facilitate quick and easy setting of the coordinate system.

PRODUCT

09



Drastic reduction of the time required to create a measurement program

Automatic Measurement Program Generation Software for Coordinate Measuring Machines  
**MiCAT Planner**

Software reads tolerance information of a 3D CAD model and automatically creates a measurement program with an optimization function to minimize measurement time. The software has a rule editor function to set and store measurement rules. Programs can be created with less quality variation between creators.

PRODUCT

10



Visualization of quality

Measurement Data Network System  
**MeasurLink**

Measurement data is statistically processed in real time to "visualize quality". Measurement data from measuring machines is centrally controlled and shared as quality information via a network server. This proactively prevents non-conforming products and strongly assists examination of problems by using aggregated data.

PRODUCT

11



Suitable for measuring large workpieces and for machine tool error evaluation

Laser Tracking System  
SpaceTrac Series

The probe collects coordinate values from the surface of the workpiece while moving and emitting laser beams onto the workpiece. It is a non-contact type and is therefore suitable for measuring elastic objects such as plastic and thin parts that may be damaged by a contact-type probe.

• Available in Japan and Southeast Asia

PRODUCT

12



All the items for every single workpiece are checked within 30 seconds

In-line Total Inspection System for Automotive Industry  
Quality Gate

Digitized image data is obtained by high-speed photogrammetry and used to evaluate the target part. All the inspection items for every single workpiece can be checked within 30 seconds; size measurement and appearance checks can also be performed. NG parts will not be passed on to the next process. Swift and precise inspection capability contributes to realizing a Smart Factory with automation and reduced downtime.

PRODUCT

13



Adopting the X-ray examination and measurement technologies developed for more than 120 years by Shimadzu Corporation

X-ray CT System for Measurement  
XDimensus™ 300

Shimadzu Corporation has been our marketing partner since September 2019. XDimensus™ 300 is our flagship model with an intersphere distance measurement error of  $3.8 + L/50 \mu\text{m}$ , which is the highest level of precision in Japan. The coordinate measuring machine, our core product, for contact and non-contact precision measurement of the external shape of objects, can cover the aspects of shape measurement that cannot be covered by the X-ray CT system for non-destructive measurement of the internal shape of objects.

• Available in Japan

PRODUCT

14



High-end machine delivering roundness, contour and surface roughness measurement functions in a single unit

CNC Roundness/Cylindricity Measuring Machine  
ROUNDTRACER EXTREME

This machine supports various shapes of workpieces such as camshafts and bearings while delivering a high level of speed, precision and usability. Integrating the functions for measuring roundness/cylindricity, contour and surface roughness into a single CNC measuring machine. Reducing takt time and improving productivity by streamlining processes.



PRODUCT

15



Integrating “contour” and “roughness” measurement

Surface Texture Measuring Instruments  
**FORMTRACER Avant Series**

This hybrid measuring system allows measurements both of contours and surface roughness. Measuring time is substantially reduced by high-speed drive of X axis (horizontal motion of stylus) and two Z axes (vertical motion of column). For substantially improved workability, an X axis inclinable drive unit capable of measuring over the inclination range of  $\pm 45^\circ$  is mounted.

**Winner of the FY2019 Good Design Award.**

PRODUCT

16



Advanced functions and enhanced usability in a compact body

Portable Surface Roughness Tester  
**Surftest SJ-210/310 Series**

This portable surface roughness tester with enhanced usability has been highly valued by many customers over the years. We offer the SJ-210 Series of user-friendly hand tools to carry with you. The SJ-310 Series also offers portability together with a built-in printer together with an array of measurement and analysis functions.

PRODUCT

17



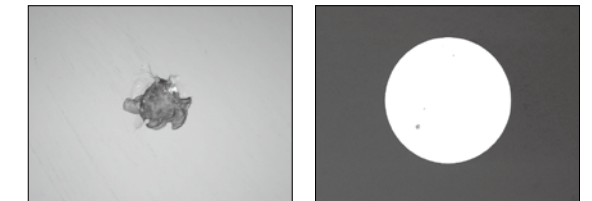
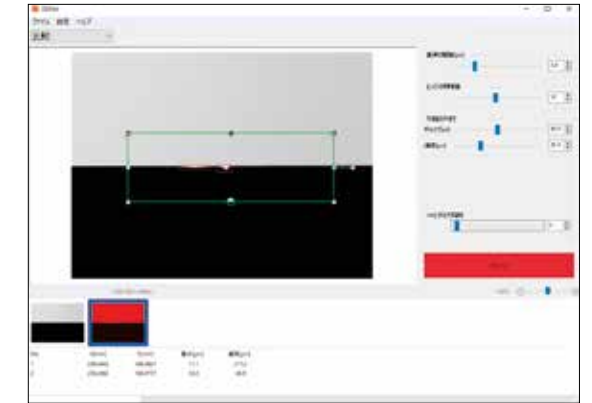
High accuracy and efficient measurement of very small features

Measuring Machine with Scanning Probe  
**MiSCAN Vision System**

The high accuracy 3D scanning of the newly developed “MPP-NANO” enables measuring small features difficult to measure by the conventional model. Also, it is equipped with multiple lighting options, the same as the Quick Vision Series’ optical system, and multi-functional 3D evaluation software to provide high performance.

PRODUCT

18



Dent on glass

Foreign substance in a pore

Adding “flaw inspection” function to image measurement

CNC Vision Measuring System Dedicated for Quick Vision  
**Flaw Inspection Software DDPak**

The flaw inspection software is dedicated to the “Quick Vision Series” CNC image measuring machine. In addition to the machine’s outstanding measurement functions for coordinates, size and geometric tolerance, it also features a dirt, burr and cracking inspection function that can be utilized to detect failures and improve production processes.

PRODUCT

19



Reliable measurement in any manufacturing environment

Profile Projectors  
**PJ-PLUS Series**

This profile projector can be operated "intuitively" even by inexperienced people. Excellent durability and energy-saving performance has been achieved by adopting a white LED illumination source. This projector can deliver stable dimension and angle measurement in manufacturing and processing sites that may be harsher than typical use environments.

PRODUCT

20



Pan focus for eliminating optical system problems

Varifocal Lens  
**TAGLENS**

The distance to the object varies. The object maybe inclined or moving. Multiple objects are captured in an image. In such cases where some part of an image is likely to be out of focus, TAGLENS immediately comes into focus across the entire view. It can eliminate problems that cannot be solved by conventional optical systems.

PRODUCT

21



High-precision, high-resolution optical scale that is also stain-resistant

Assembly Type Linear Scale Unit for Absolute Systems  
**ABS AT1300**

This high-precision linear scale is designed to be more reliable than conventional scales. The slim and space-saving absolute scale has a best-in-class minimum resolution of 0.001  $\mu\text{m}$ . Its new detection mechanism provides higher environmental resistance than ever.

PRODUCT

22



High-speed, high-precision non-contact measurement

Laser Scan Micrometers  
**LSM-6902H**

This laser scan micrometer has a measurement range of 25 mm, providing one of the world's best levels of measurement accuracy. With a high level of precision enabled by adopting an ultra-high-precision scan motor, this micrometer with its excellent measurement accuracy ensures customer satisfaction in respect of outside diameter measurement of pin gages, limit gages, rollers for bearings, motor shafts and other precision parts.



PRODUCT

23



Test large and heavy parts

High-End CNC Rockwell Hardness Testing Machine  
**HR-600 Series**

Supports Rockwell and Brinell hardness testing on a single machine. The HR-600 Series can test a wide variety of workpieces, ranging from those made of hard metal, such as crankshafts, to softer workpieces. With the fixed table type, large and heavy workpieces such as cylinder blocks can be tested. Using the X-axis stage (optional) enables more effective Rockwell hardness testing.

PRODUCT

24



Inner wall hardness measurement  
without workpiece destruction

Rockwell Hardness Testing Machines  
**HR-500 Series**

An internal feature down to 34 mm in diameter can be measured without needing to section the workpiece, which diameter can be reduced to 22 mm if an optional accessory is used. The operation panel can be switched according to the application and is mountable on the machine. Also, thanks to the versatile electronic control, hardness tests including Rockwell, Rockwell superficial, Brinell, indentation depth Brinell and plastic can be performed.

PRODUCT

25



Minimizing human error in measurement

High-Accuracy Digimatic Micrometer  
**MDH-25MB**

This Digimatic micrometer enables measurement of 0.1 μm to meet the demand for high-precision measurement. The ratchet thimble with built-in bearing can minimize the impact of external force. The micrometer delivers stable measurement by adopting a rolling interface instead of the conventional sliding interface.

PRODUCT

26



Support for height measurements  
with high accuracy

High Precision Height Measuring Instruments  
**QM-Height Series**

Height measuring machine achieving best-in-class accuracy of  $\pm(2.4 + 2.1L/600)$  μm. In addition to individual height measurement, maximum and minimum heights and slope of sculptured surfaces can be measured by means of grade difference, internal/external width, internal/external diameter, central pitch of circle and profile measurements. Thanks to its air suspension mechanism, the machine can be easily moved across the reference surface plate.

PRODUCT

27



Promotes Smart Factory

Measurement Data Wireless Communication System  
**Mitutoyo Bluetooth® U-WAVE**

Measurement data obtained by using calipers and micrometers can be sent to a PC, smartphone, tablet or other device via Bluetooth®. Up to seven tools can be connected to a Windows based PC or laptop having an enabled Bluetooth® receiver. This software collects measurement data in real-time at low cost, helping to achieve visualization of quality linking with “MeasurLink”.

## Mitutoyo video website

You can view more than 30 videos about our products at any time on this website.



PRODUCT

01

Shop-floor Type CNC Coordinate Measuring Machine

**MiSTAR 555**



<https://bcove.video/32g0vMJ>

PRODUCT

14

CNC Roundness / Cylindricity Measuring System

**ROUNDTRACER EXTREME**



<https://bcove.video/341pYet>

PRODUCT

17

Measuring Machine with Scanning Probe

**MiSCAN Vision System**



<https://bcove.video/2UM3kkq>

PRODUCT

23

High-End CNC Rockwell Hardness Testing Machine

**HR-600 Series**



<https://bcove.video/2PwHKzC>



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