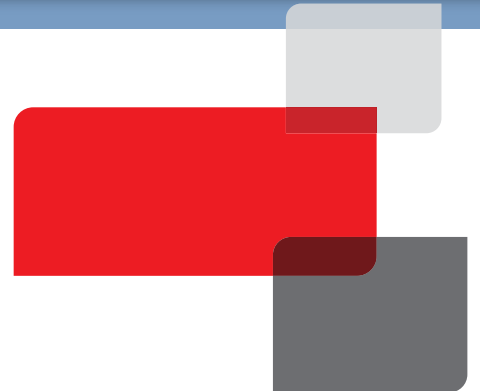FACTORY AUTOMATION

NUMERICAL CONTROL (CNC)
NC MachiningAID
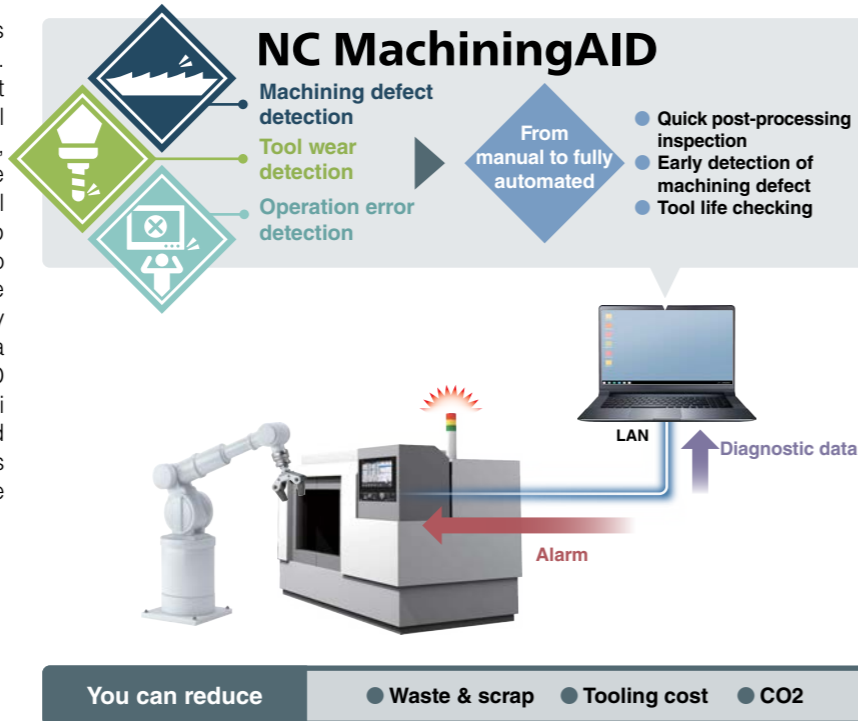
AI Diagnostic Tool for CNC Machining

AI & machine learning based machining diagnostic tool

NC MachiningAID

Maisart

Today, we have seen various problems on CNC shop floors. Skilled workers are very few, part variety is getting wider, capital cost for automation is increasing, and material and tools are getting expensive, which are all unavoidable causes that push up the cost. Even after you decide to start using DX, you may often face technical problems such as difficulty in understanding how the data should be used. NC MachiningAID retrieves and analyzes the Mitsubishi Electric's CNC machining data and automatically performs diagnostics to realize full automation and reduce your machining costs as well.
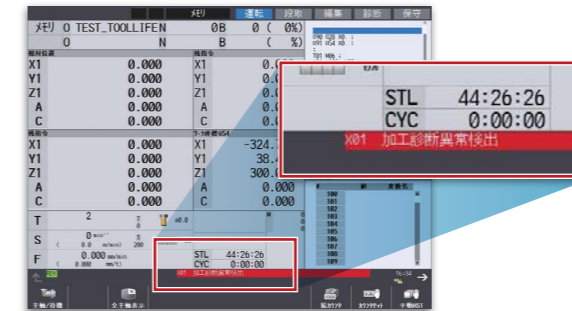
NC MachiningAID

- **Machining defect detection**
- **Tool wear detection**
- **Operation error detection**

From manual to fully automated

- Quick post-processing inspection
- Early detection of machining defect
- Tool life checking

LAN
Diagnostic data
Alarm

You can reduce	● Waste & scrap ● Tooling cost ● CO2

What is Maisart ?

Machining defect detection

Eliminates unsatisfactory machining with accurate diagnostic technologies!
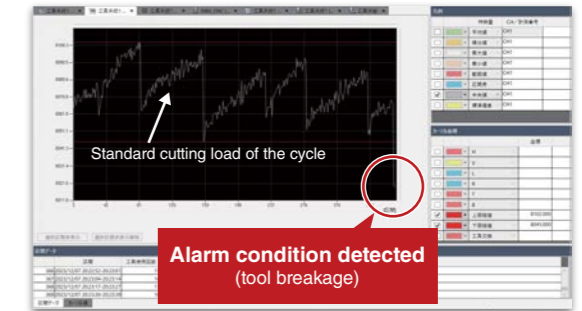
Machine shops are required to be able to handle fluctuating production demands. NC MachiningAID automatically learns the good machining condition and generates an alarm when it detects bad machining. This works like a manual quick inspection traditionally done by a human. In combination with a robot, the manual operation can be completely automated.

■ Alarm indication during machining (with cycle stop)
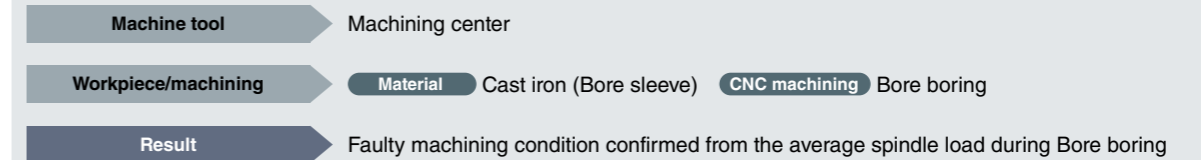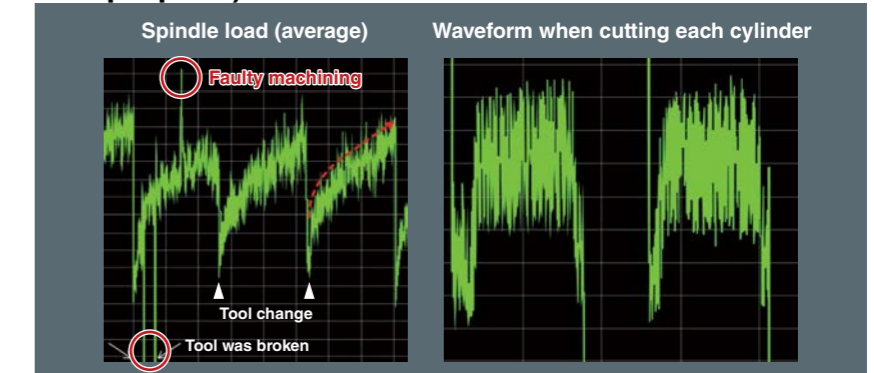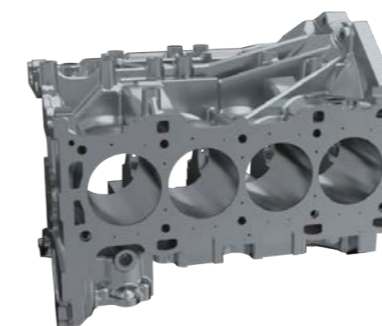
Monitor screen

| STL | 44:26:26 |
| CYC | 0:00:00 |

NC MachiningAID Trend Indication

Standard cutting load of the cycle

Alarm condition detected
(tool breakage)

Falling below a threshold means the tool is broken

Use Case	**Car engines**

Abnormal machining diagnosis of bore boring

Machine tool	Machining center
Workpiece/machining	**Material** Cast iron (Bore sleeve) **CNC machining** Bore boring
Result	Faulty machining condition confirmed from the average spindle load during Bore boring

■ Machined part (for illustration purpose)

Spindle load (average)

Faulty machining

Tool change

Tool was broken

Waveform when cutting each cylinder

Tool wear detection

Automatically learns tool life. Suggests tool change with perfect timing to reduce your tooling costs!

NC MachiningAID automatically identifies the feature associated with tool wear from the features of each axis and the correlation between the tool usage, then automatically learns the tool life on a process-by-process basis. Once trained, the NC MachiningAID predicts the tool deterioration (erosive wear) on a machining-by-machining basis, and when the tool is nearing the end of its life, it indicates a corresponding CNC alarm message to organize the user to change the tool.

■ **The control does not stop the operation when alarmed, warned or alerted due to a tool wear.**

Monitor screen

NC MachiningAID Trend Indication

Tool wear (predicted)
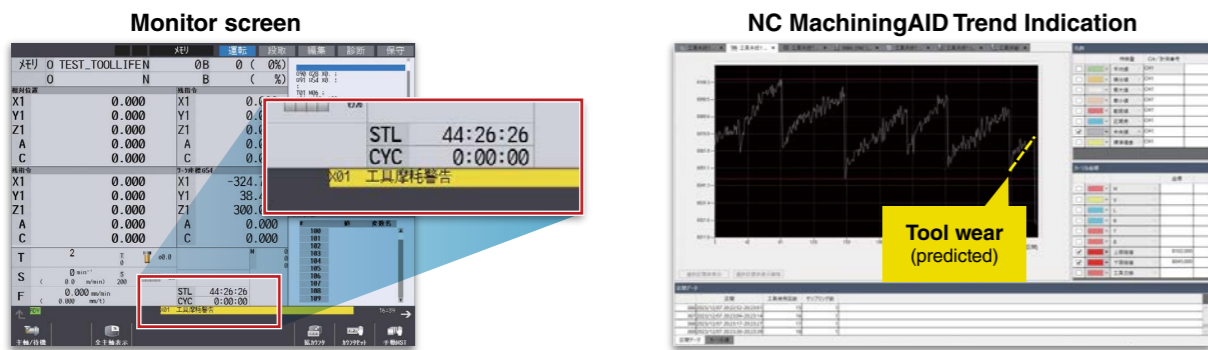
Use Case   Machining an artificial joint

Turning tool wear diagnostics

Machine tool	Lathe machine
Workpiece/machining	Material Cobalt-chromium alloy CNC machining Turning
Result	Monitors tool wear during precision machining to achieve solid surface quality.

■ **Machined part (for illustration purpose)**

Spindle load (average)

Tool life

Normal machining

Air cut
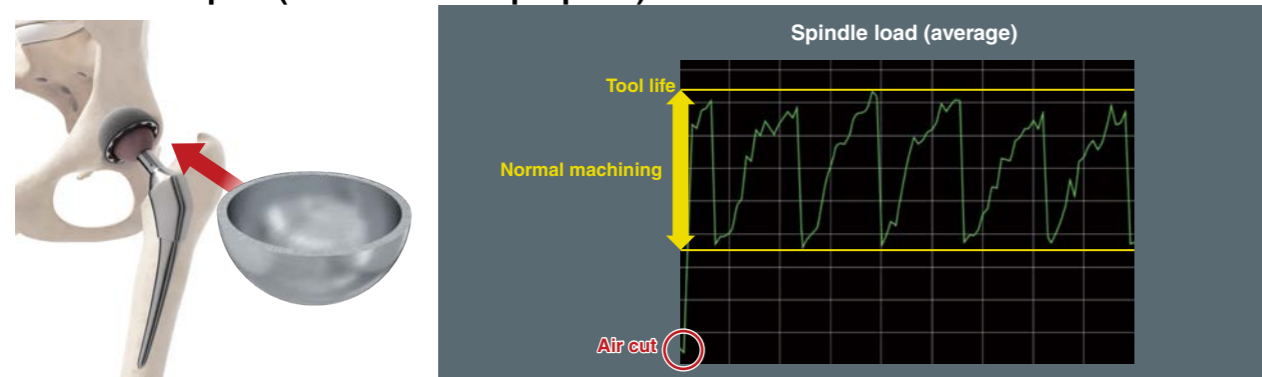
Operation error detection

Eliminates Human Error and Reduce the Risk of Scrap!

Variation of production and High-mix Low-volume manufacturing are often the cause of human error. How we can minimize the risk of human error is our important topic. NC MachiningAID automatically learns the conforming cut and detects errors, such as inadequate coolant discharge rate, improper workpiece chucking, and incorrect tool compensation settings. This is also applicable to machining errors caused by incorrect robot maneuvers.
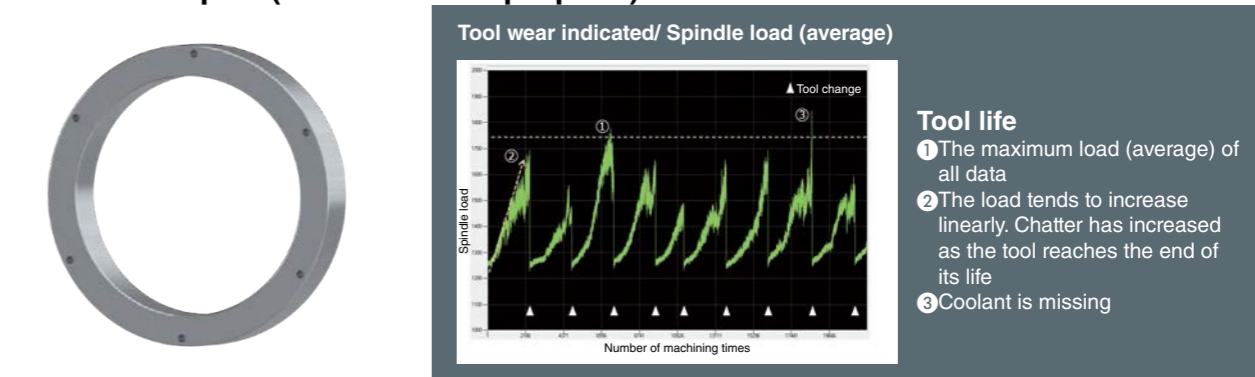
■ **Alarms related to human errors**

Monitor screen

NC MachiningAID Trend Indication
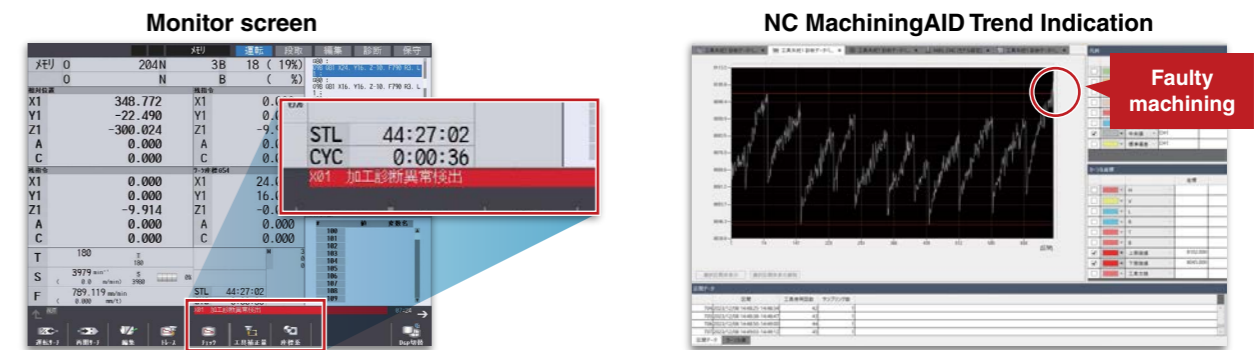
Faulty machining

Compares to upper threshold to detect human error

Use Case   Tapping (screw) operation for electric part

Tapping Diagnosis of faulty machining

Machine tool	Machining center
Workpiece/machining	Material FCD CNC machining Tapping
Result	It is confirmed that tool wear during tapping and chatter of the worn tool can be used to detect human error.

■ **Machined part (for illustration purpose)**

Tool wear indicated/ Spindle load (average)

▲Tool change

Spindle load

Number of machining times

Tool life
❶ The maximum load (average) of all data
❷ The load tends to increase linearly. Chatter has increased as the tool reaches the end of its life
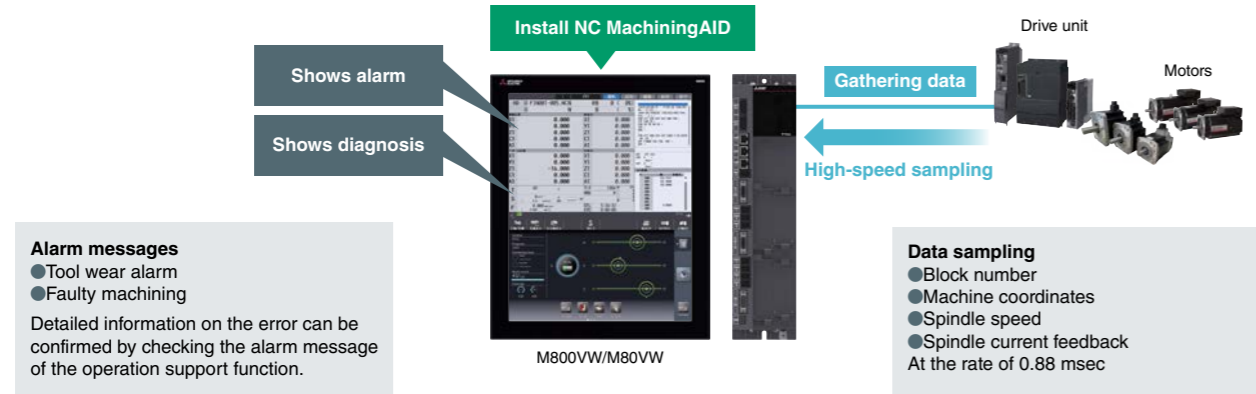❸ Coolant is missing

System configuration

Diagnostic yet Simple Device Configuration!
All you need is a PC software!

- Just install a NC MachiningAID software on your Windows PC
  (M800VW/M80VW CNC PC unit is also available for the installation)
- M800VS/M80V supports adjusting the screen to fit the output device, such as IPC or laptop PC
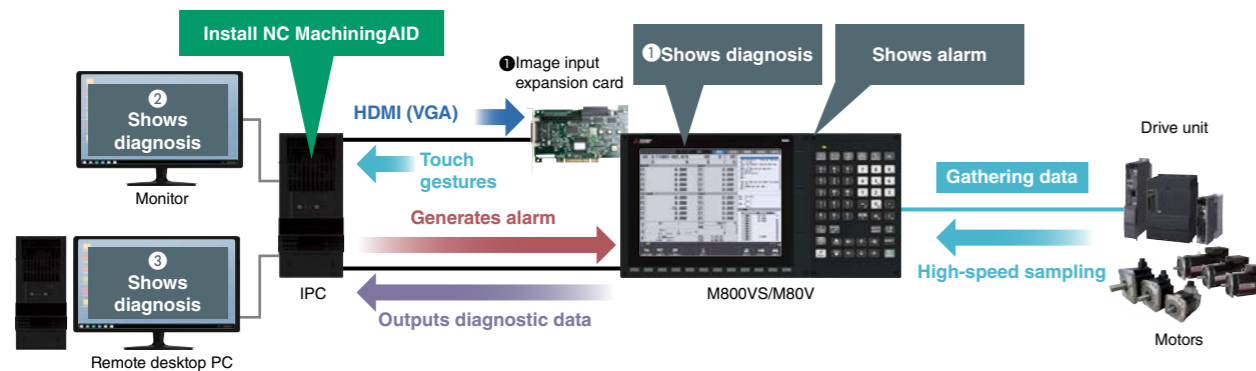
M800VW/M80VW

Install NC MachiningAID

Shows alarm

Shows diagnosis

Drive unit

Motors

Gathering data

High-speed sampling

Alarm messages
- Tool wear alarm
- Faulty machining

Detailed information on the error can be confirmed by checking the alarm message of the operation support function.

M800VW/M80VW

Data sampling
- Block number
- Machine coordinates
- Spindle speed
- Spindle current feedback
At the rate of 0.88 msec

M800VS/M80V+PC

Install NC MachiningAID

Shows alarm

Shows diagnosis

Generates alarm

Outputs diagnostic data

PC

Drive unit

Motors

Gathering data

High-speed sampling

M800VS/M80V

M800VS/M80V+IPC
+ (❶Image input expansion card, ❷Monitor, or ❸Remote desktop PC)*1

*1. Select one of ❶, ❷ or ❸ for the display device of the diagnosis screen.

Install NC MachiningAID

❷ Shows diagnosis

Monitor

❸ Shows diagnosis

Remote desktop PC

IPC

HDMI (VGA)

Touch gestures

Generates alarm

Outputs diagnostic data

❶ Image input expansion card

❶ Shows diagnosis

Shows alarm

Gathering data

High-speed sampling

M800VS/M80V

Drive unit

Motors

Before You Start NC MachiningAID

M800VW/M80VW

■ Before you start diagnostics

STEP 1 Setup
Install

Install

Start your automatic diagnostics

STEP 2 Before you run diagnosis
Train your machine learning model
- Normal machining process x1
- Air cut x1
- Normal machining process with 5 times of tool change

Setup your automatic diagnostics

STEP 3 Start diagnostics
Apply diagnostics to your production process

Start your automatic diagnostics

You don't need to be a data scientist or a machining diagnostics specialist.
NC MachiningAID automatically sets up the data it needs to learn.

M800VS/M80V+IPC

■ Before you start diagnostics

STEP 1 Setup
- Install
- Connect your PC and CNC on a LAN

Not included in the package
- IPC or PC (standard)
- Laptop PC

Install

LAN

STEP 2 Before you run diagnosis
Train your machine learning model
- Normal machining process x1
- Air cut x1
- Normal machining process with 5 times of tool change

Setup your automatic diagnostics

LAN

STEP 3 Start diagnostics
Apply diagnostics to your production process

Start your automatic diagnostics

LAN

You don't need to be a data scientist or a machining diagnostics specialist.
NC MachiningAID automatically sets up the data it needs to learn.

■ NC MachiningAID Operating Environment

		NC MachiningAID	
		M800VW/M80VW	**M800VS/M80V**
Operating system requirements			
PC unit	FCU8-PC232	●	-
Not included in the package - IPC or PC (standard spec)	Intel® celeron processor 2.4Ghz or higher, Memory 4GB or higher, 6GB or higher	●	●

Applicable CNCs M80V, M80VW, M800VS, M800VW

■ Coverage and Notice

Applicable operations	Drilling, Milling, Tapping, Reaming, Lathe turning, Screw cut, Hobbing, Skiving
Applicable materials	Titanium, Chromium alloy, Cast iron, Tool steel, Stainless, Aluminum, Alloyed metal, Ceramics
Applicable workpiece (parts)	Repetitive mass production running in the same machining program that is determined to be diagnosed (with a constant volume of cuts per a unit time (of each coordinate during the process. For example, ≥30 parts/day of mass production).
Other requirements	• Modify your G code program • Activate the Tool Life Management on your CNC
NC MachiningAID cannot diagnose the process when	• The current data of the air cut is little different from that of the cutting operation; • The program is used for different types of operations, such as scale removal, different cutting profiles, or different workpiece sizes; • The current output varies with changing feedrate, such as override or automatic control.

■ Usage Note

When operating in High-speed High-accuracy Control, when processing a significantly large number of segments, when using CC-Link IE Field Basic, or when using DRC, the data collection and sampling can be restricted to protect the CNC processing from CPU load. Please contact our sales department if you want to use these functions with NC MachiningAID.

Note	● The functions and features described in this document are subject to change without notice. ● The use cases described in this document are examples from our customers; however, Mitsubishi Electric does not guarantee the validity of these applications.

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⚠ Safety Warning

To ensure proper use of the products listed in this catalog, please be sure to read the instruction manual prior to use.

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