Digitalization and IoT in the machine tool industry
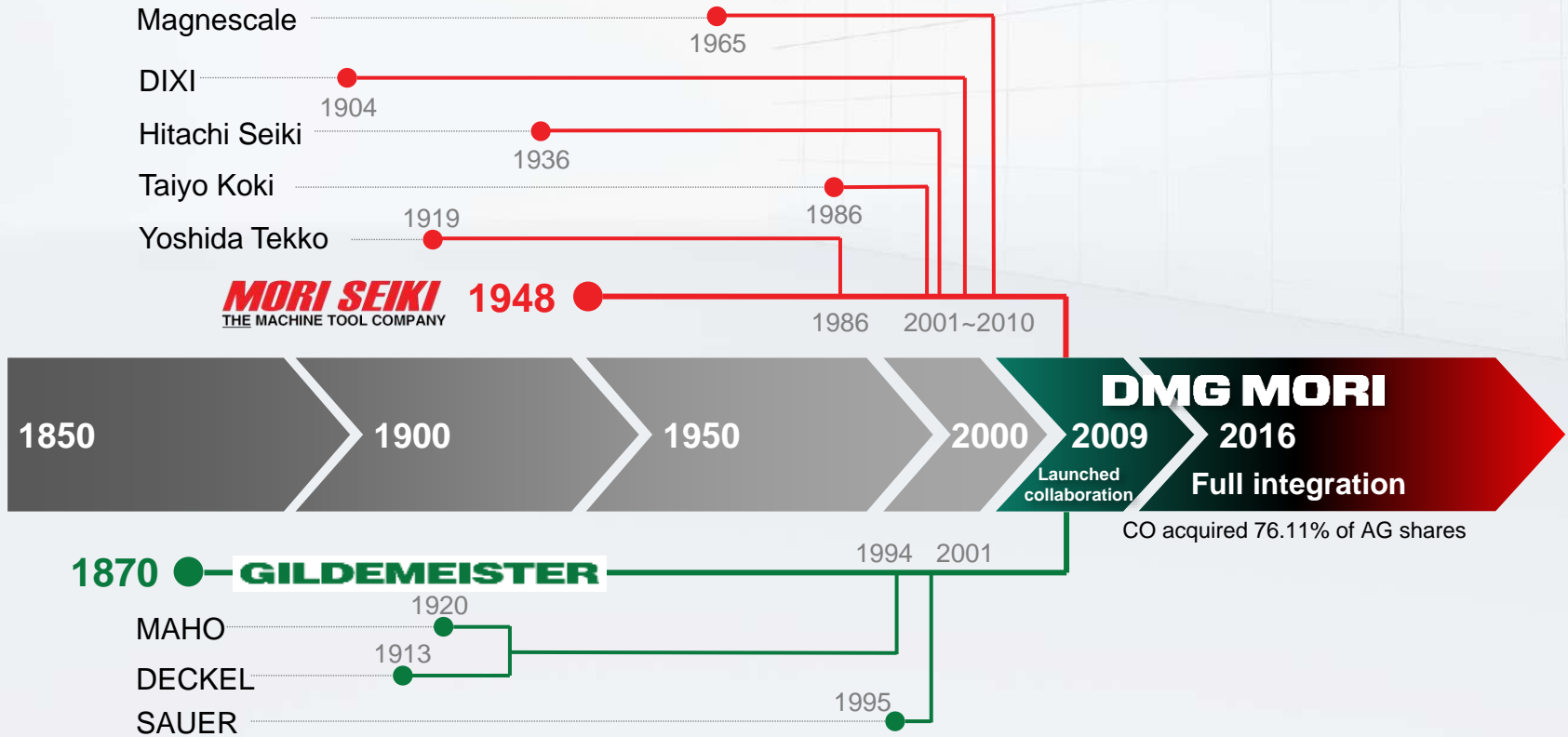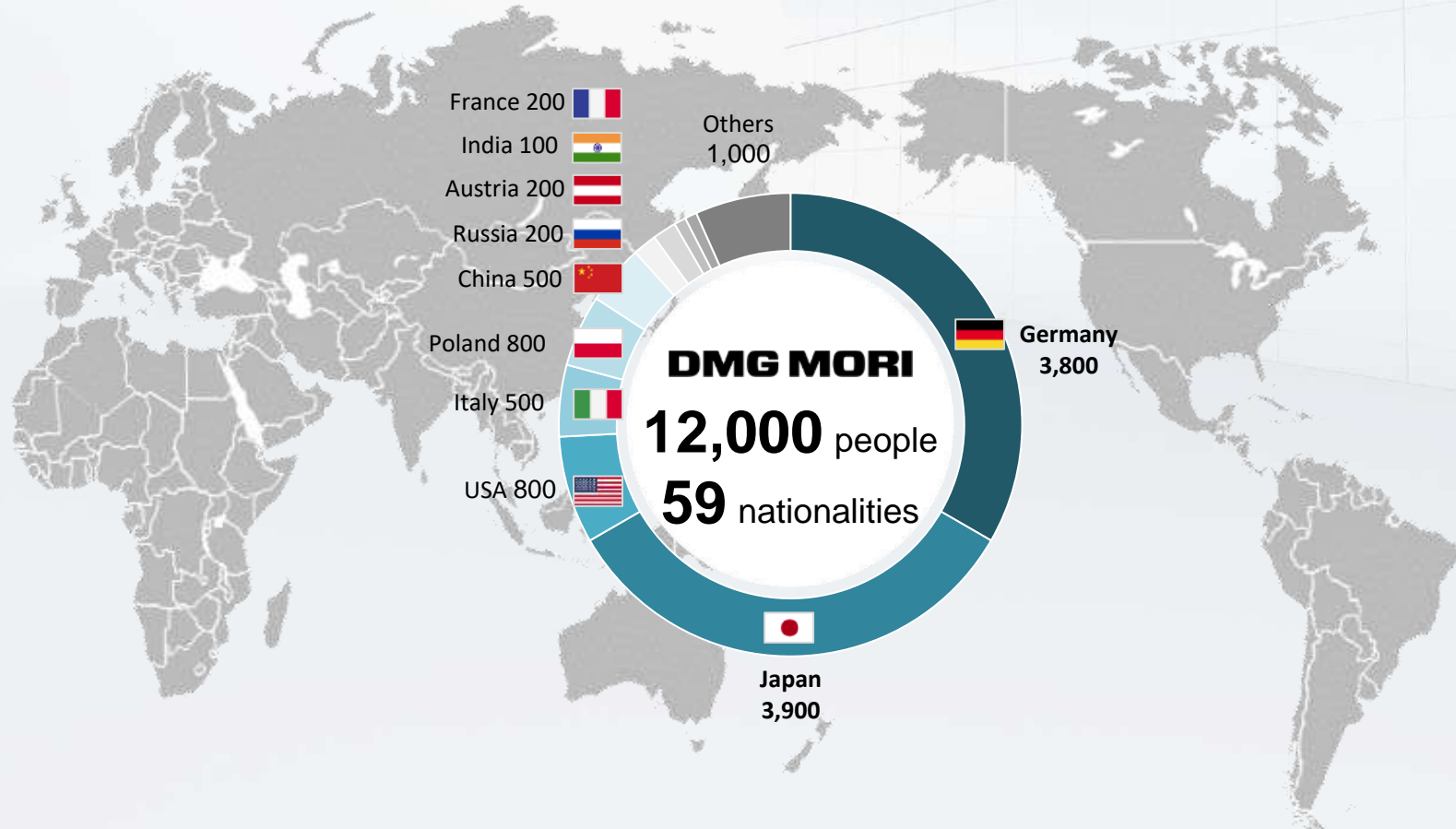
DMG MORI CO., LTD.

COO Technium

Kentaro Blumenstengel

DMG MORI CO., LTD.

DMG MORI

Representative	Dr. Masahiko Mori
Established	26 October **1948**
Stock Listings	First Section of Tokyo Stock Exchange Frankfurt Stock Exchange (SDAX index)
Business	Offering total manufacturing solutions including **machine tools, software, measuring, service / support, application, engineering**
Turnover	**396.0 bn JPY** / **3.05 B-EUR** (Result: Jan.-Dec. 2021 / 1 EUR = 129.9 JPY)
No. of Employees	**12,000** people
Operation Bases	**Tokyo Global Headquarters** (Shiomi, Tokyo) Iga Campus (Iga, Mie) Nara Campus (Yamato-Koriyama, Nara) Germany (Bielefeld, Pfronten, Seebach, Stipshausen) Italy (Bergamo, Tortona) USA / China / Poland / Russia

DMG MORI

Magnescale — 1965

DIXI — 1904

Hitachi Seiki — 1936

Taiyo Koki — 1986

Yoshida Tekko — 1919

MORI SEIKI THE MACHINE TOOL COMPANY — **1948**

1986   2001~2010

1850	1900	1950	2000	**DMG MORI** 2009	2016

2009 Launched collaboration

DMG MORI 2016 **Full integration**

CO acquired 76.11% of AG shares

1870 **GILDEMEISTER**

1994   2001

MAHO — 1920

DECKEL — 1913

SAUER — 1995

R&D / MANUFACTURING

DMG MORI

Poland — Pleszew

Russia — Ulyanovsk

China — Tianjin

Tianjin（No.2 Plant）operation start in 2025
Shanghai operation start in 2023

USA — Davis CA

Cairo, Egypt operation start in 2023

Germany — National Headquarters, Bielefeld / Pfronten / Seebach / Stipshausen

Italy — Tortona / Bergamo

Japan — Manufacturing Headquarters, Iga / Nara / Nara / System Solution Plant / Niigata / TAIYO KOKI / Kanagawa / Magnescale

R&D	1,300 people
Production	2,800 people
Quality	400 people
Purchase	800 people
Managing	800 people

7 COUNTIES | **16** factories | **6,100** people | **12,000** machines per year

DMG MORI

TURNING TECHNOLOGY

MILLING TECHNOLOGY

ULTRASONIC

LASERTEC

ADDITIVE MANUFACTURING

AUTOMATION

Drive shaft

Compressor disk

Gyro-compass

Turbine vane

Blow mould

AGV Robot

Hydraulic component

Landing gear

Watch case

Steering wheel cap mould

Drillbit

INTEGRATED DIGITIZATION

TECHNOLOGY EXCELLENCE

TRAINING

SERVICE

PROCESS INTEGRATION, AUTOMATION, DIGITIZATION
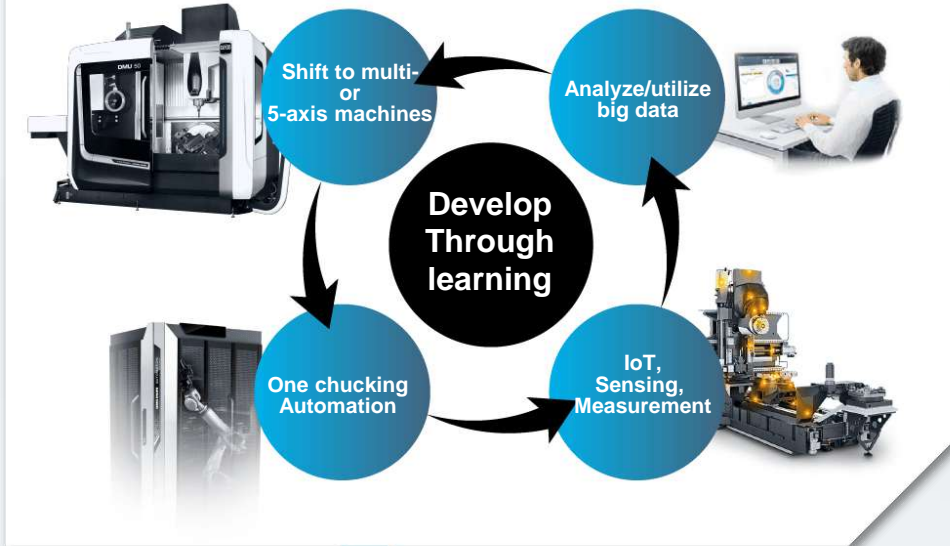
DMG MORI

umati is a trademark or registered trademark of Verein Deutscher Werkzeugmaschinenfabriken e.V.
OPC UA is a trademark or registered trademark of OPC Foundation
MQTT is a trademark or registered trademark of International Business Machines Corporation
MTconnect is a trademark or registered trademark of The Association For Manufacturing Technolog

DMG MORI

AUTOMATION

DIGITIZATION

PH Cell

LPP and MCC-LPS

DMG MORI
DIGITAL TWIN

ADDITIVE MANUFACTURING

TULIP

CELOS

my DMG MORI
CUSTOMER PORTAL

Planning

Preparation

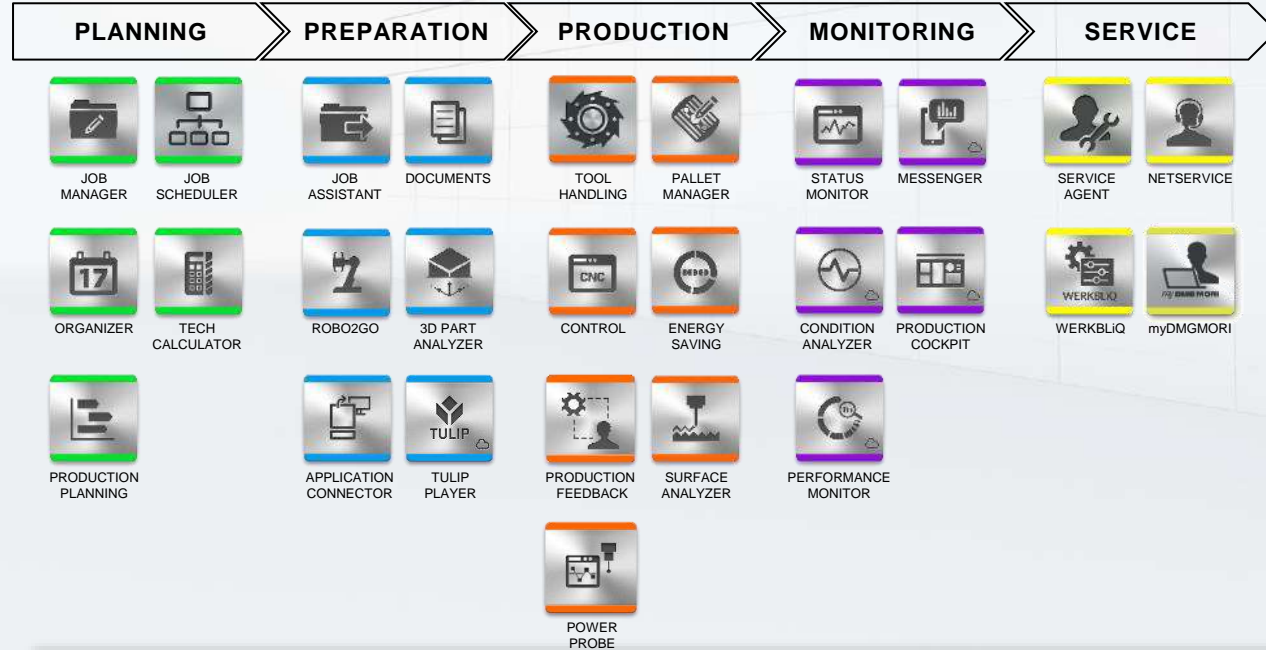Production

Monitoring

Services

PLANNING	PREPARATION	PRODUCTION	MONITORING	SERVICE

JOB MANAGER · JOB SCHEDULER · JOB ASSISTANT · DOCUMENTS · TOOL HANDLING · PALLET MANAGER · STATUS MONITOR · MESSENGER · SERVICE AGENT · NETSERVICE

ORGANIZER · TECH CALCULATOR · ROBO2GO · 3D PART ANALYZER · CONTROL · ENERGY SAVING · CONDITION ANALYZER · PRODUCTION COCKPIT · WERKBLiQ · myDMGMORI

PRODUCTION PLANNING · APPLICATION CONNECTOR · TULIP PLAYER · PRODUCTION FEEDBACK · SURFACE ANALYZER · PERFORMANCE MONITOR

POWER PROBE

+ **Start in 2013 –** with 11 APPs
+ **Today – 27 CELOS APPs** for integrated workflows from planning to service
+ **Easy integration** of own systems (e.g. MES, ERP, CAM,...)
+ **Direct job import** from own ERP & MES systems

DIGITAL SOLUTION

DMG MORI

+ *Digital solutions achieving overwhelming productivity*

PLANNING	PREPARATION	PRODUCTION	MONITORING	SERVICE

PLANNING

- Machining-related data can be centrally managed with CELOS-PC Version.
- CELOS-PC Version is also helpful in reviewing production plans at busy periods or when an urgent production request arises.

PREPARATION

- CELOS apps ensure efficient NC programming with CAD / CAM.
- DMG MORI also provides post-processor solutions.

PRODUCTION

- Information required by an operator can be directly sent from a CELOS-PC to a machine.
- Machining information can be easily viewed on CELOS.
- A wide variety of CELOS apps facilitate machining operation.

MONITORING

IoT connector
Ensures safe networking of multiple machines

MESSENGER
Visualizes operating status of networked machines

CONDITION ANALYZER
Allows for early identification of machine and machining problems based on machine data recorded by on-machine sensors.

SERVICE

CELOS Club
Provides strong support for your factory digitization and offers software and services for greater productivity

NET SERVICE
Remote support by DMG MORI Service Center minimizes machine downtime caused by machine trouble.

Benefits of digitization

- ✓ Eliminate unnecessary maintenance costs
- ✓ Early recovery from machine stop
- ✓ Get useful hints for higher productivity

5G verification test started

- ✓ Verification test on 5G next-generation communication standards started at Iga Campus

① WHY CONNECTIVITY?

Data is the basis for optimizing the shopfloor by digitization

② WHAT YOU GET?

+ Secured and standardized machine data interface OPC UA / UMATI, MTConnect, MQTT

+ Simple connection to existing systems, such as MES

+ 17 machine signals directly via the IoT*connector* for new and inventory machines from 2013

③ YOUR PATH TO CONNECTIVITY
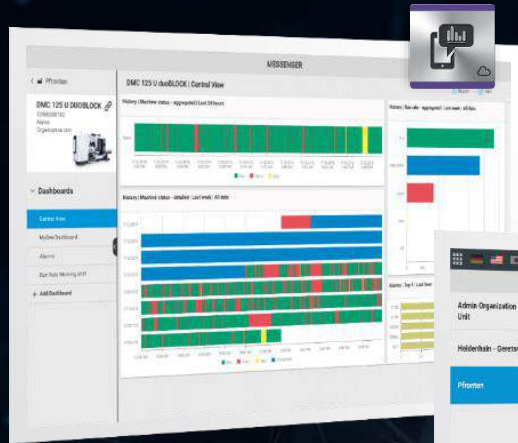
for your entire shopfloor

17 MACHINES SIGNALS AS STANDARD

MACHINE DATA
1. Serial number of the machine
2. Operating hours
3. Switch-on hours

MACHINE STATUS
4. Status indicator light
5. Number of alarms
6. Messages, alarms & warnings
7. Control mode
8. Machine execution status

PRODUCTIVITY
9. Workpiece counter current
10. Workpiece counter total
11. Target number of workpieces
12. Current program runtime

PROCESS DATA
13. Spindle speed override
14. Rapid traverse override
15. Feed rate override
16. Active tool
17. Name of current NC program

ADDITIONAL MACHINE SINGALS
Machine specific signals, e.g. Spindle speed, Coolant status, etc.

SHOPFLOOR

DMG MORI

CONNECTIVITY by DMG MORI

Free of charge in standard with the IoT*connector*

Retrofittable with **Monitoring Service**

NEW MACHINES

INVENTORY MACHINES

Inventory machines before 2013

Individual solution after case-by-case examination

3rd Party MACHINES

PERIPHERY WASHING MEASURING DEBURRING etc.

CONNECTIVITY by **DMG MORI**

DETECT DOWNTIMES

Configurable
Dashboards

Machine status
at a glance
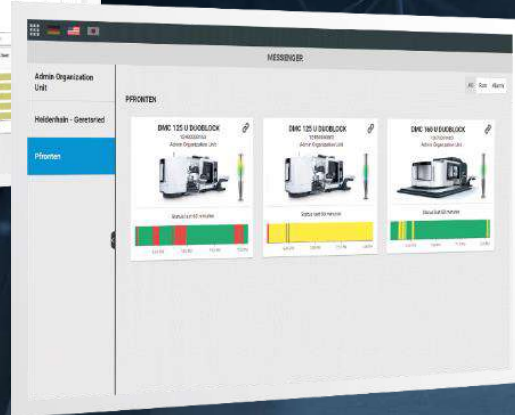
Automatically generated
one page reports

- **+ Machine status at a glance**
- **+ For all connected machines:**
  DMG MORI, 3rd party & non-machine tools
- **+ Individual** configurable dashbord
- **+ Automatically generated one-page reports**

TULIP

DMG MORI

BUILD YOUR OWN APP!

THE SIMPLEST WAY TO DIGITIZE YOUR SHOPFLOOR PROCESSES

EMPLOYEE-CENTRIC

+ Enables employees to digitize processes themselves
+ Bottom-up approach for digital solutions

NO CODE

+ Create your own APPs without any programming experience
+ Supports employees in performing complex tasks

APP TEMPLATES
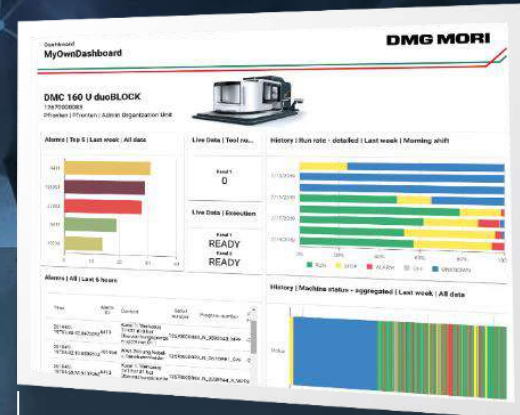
+ Powerful best-in-class tools
+ Faster innovations with customizable app templates

25 % cycle time reductions!

90 % shorter training period!

98 % less error rates!

BOTTOM UP TO A PERFECT SHOPFLOOR PROCESS
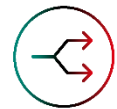
Personal
Individual process management with "individual" TULIP APPs

Progressive
Easy integration of external data sources via drag & drop

Visual
Images, graphics and videos support process control

DIGITAL SOLUTION   my DMG MORI

+ Web-based integrated management of DMG MORI machines at customers' shops

+ Quick and easy access to necessary data & information, such as manuals and service history

YOUR HISTORY

YOUR MACHINES

my DMG MORI CUSTOMER PORTAL

YOUR DOC...

STATUS QUO:
> **20,000**
CUSTOMERS
> **100,000**
MACHINES

Manual
- Can be downloaded and viewed whenever necessary
- Keyword search for quick jump to desired page

Service History
- At-a-glance checking of individual machine information such as serial No., delivery date and warranty period

Machine List
- Comprehensive security measures to protect customers' important information

Security
- Comprehensive security measures to protect customers' important information

CELOS Club Members-only contents
- Operation report download
- Latest software download
- CELOS Club renewal application

DIGITAL TWIN TEST CUT

Send machining information	Digital Twin test cut	Receive results

- CAM data
  NC program

- Workpiece info
  Material / shape
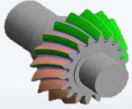
- Tool info
  Material properties
  geometry

Real machine
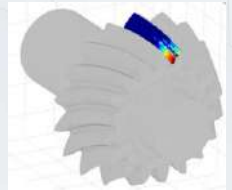
Modeling

Digital Twin (physical property model)
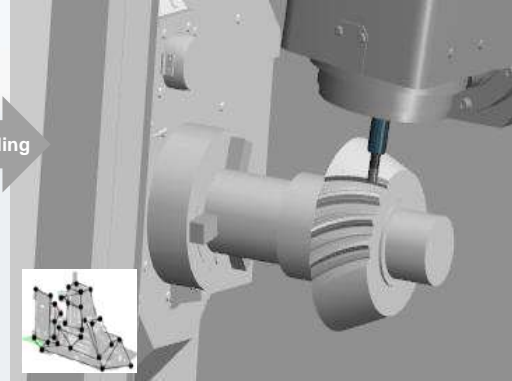
- Cycle time, vibration

Real
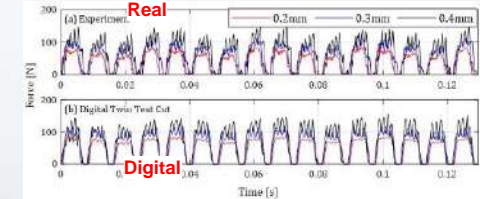
Digital

- Surface quality

- ✅ Simulation instead of machine
- ✅ No workpiece and tool costs
- ✅ Safe test cut and quick response
- ✅ Lower effort for cycle time estimation

DIGITAL TWIN TEST-CUT POWERED BY "FUGAKU"

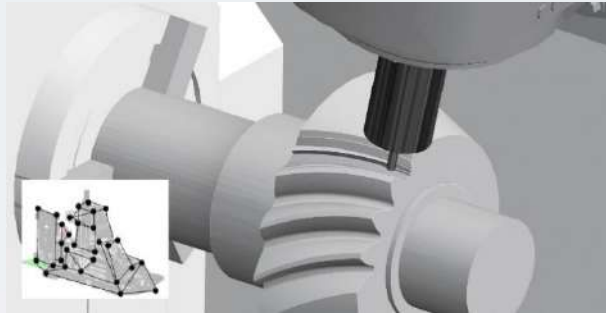"Fugaku" (the supercomputer of RIKEN) integrated into Digital Twin test-cut

Outcome
①Test-cut simulation finished in 10 min. (-98% compared to 8 hrs of physical test-cut)
②Environment-friendly: tools, workpieces, coolant not necessary

8 hrs. with physical test-cuts

10 min. with Digital Twin test-cut powered by "Fugaku"

©RIKEN

This work used computational resources of the supercomputer "Fugaku" through the HPCI System Research Project (Project ID: hp210202)

DIGITAL TWIN SHOWROOM

Iga Global Solution Center and
System Solution Center
in full CG (4K image quality)

Digital Twin Showroom

+ 46 machines and 200+ contents
+ More than 40 DMQPs
+ Online seminars

System solution center

+ 15 automation systems

46 machines
15 systems

Various contents

External Machine View

Internal Machine View

COMPLETELY CARBON NEUTRAL
AT ALL PRODUCTION BASES ACROSS THE WORLD

DMG MORI
CO₂ neutral

DMG MORI
GREEN MODE

UP TO **25**% ENERGY SAVING*

+ Reduces machining time by bringing the best out of machines/tools for higher cutting conditions

+ Saves power consumption during stand-by time by shutting off power of the spindle, chip conveyor and coolant pump

+ Visualizes power consumption and CO2 emissions

*The saving effect may vary depending on the machines, cutting conditions and measuring environments.

---

100 % CLIMATE-NEUTRAL MACHINE MANUFACTURING

SUPPLIERS + **DMG MORI**

MACHINE UTILIZATION

CUSTOMER

DMG MORI
GREEN MACHINE

NEUTRAL CO₂ FOOTPRINT FOR ALL DMG MORI MACHINES – FROM RAW MATERIALS TO DELIVERY

1. PRODUCT CARBON FOOTPRINT NEUTRAL ✓

All machines delivered since January 2021 are manufactured in a climate-neutral manner worldwide.

2. COMPANY CARBON FOOTPRINT NEUTRAL ✓

DMG MORI has been climate neutral in its own operations since May 2020.

DMG MORI
GREEN MODE

ENERGY- AND EMISSION-EFFICIENT MACHINE OPERATION

1. Up to 30 % energy savings compared to previous machine models
2. Opens up access to many state subsidy programs – get in touch with us! ✓

DMG MORI
GREEN TECH

EXCELLENCE IN GREEN TECHNOLOGIES

1. Green technologies like wind power and electromobility are the most important levers against climate change
2. DMG MORI is the innovation driver for green production technologies ✓

CO2 EMISSIONS REDUCTION - ROADMAP UNTIL 2030

Solar power generation (Bielefeld, GER)

Responded to CDP Climate Change Questionnaire
Committed to TCFD-aligned disclosure
Joined SBT initiative, obtained SBT approval

SCIENCE BASED TARGETS

Izumo: Electric furnace for casting production + CO2-free electricity

Solar panels to be installed on factory roofs (Iga, Nara)

| 2010 | 2015 | 2020 | 2021 | 2024 | 2025 | 2030 |

Process integration to save energy (Iga, JPN)

Introduction of CO_2-free electricity

Emissions reduction in Scope 3
▶**Upstream (purchased goods and services)**
·Collaboration with suppliers
·Optimized logistics
·Provision of our products and technologies
▶**Downstream (use of sold products)**
·Energy-saving products with Green Mode Technology
·Promotion of process integration, automation
·Visualization of CO2 emissions by IoT (i.e. *my* DMG MORI)

5-side portal machine
50 units

5-axis DMC340
10 units
42% less energy consumption

Achieved global carbon neutrality
(Scope 1, 2 Scope 3 Upstream)

DMG MORI
CO₂ neutral