

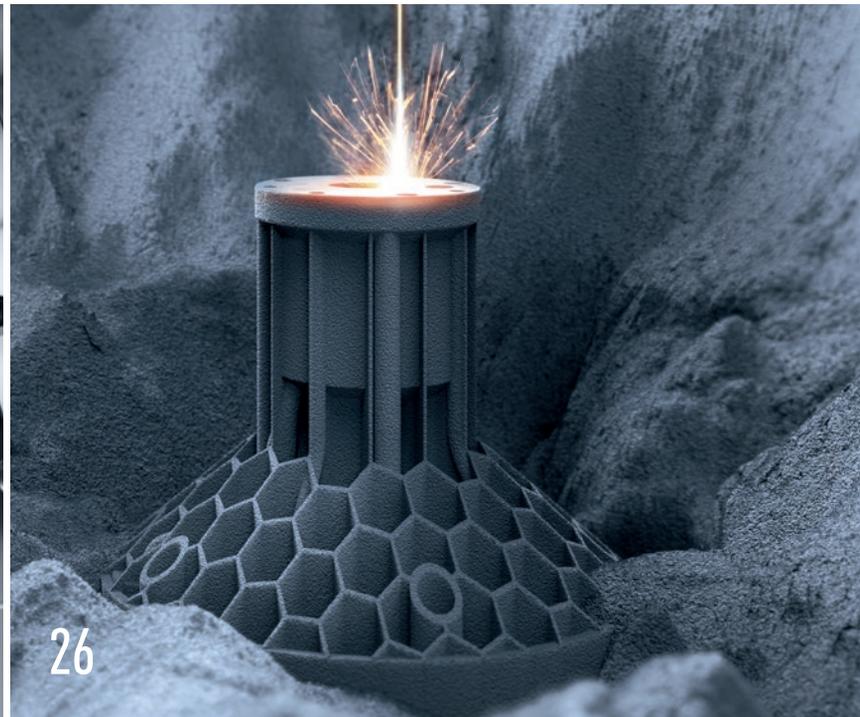
# TECHNOLOGY EXCELLENCE



FRAGILE. USE PROTECTIVE PAD  
WHEN WORKING IN BELLYCUT  
LIMIT 2 PERSONS AT ONE TIME



10



26

**INSIDE DMG MORI – IGA CAMPUS**  
Tradition meets High-tech ..... 04

**INTERVIEW – „FIRST QUALITY“**  
„First Quality“ without compromise ..... 10

**DMG MORI COMPONENTS**  
36 months warranty for MASTER spindles  
with unlimited spindle hours ..... 12

**CELOS FROM DMG MORI**  
Integrated digitization solutions ..... 14

**DMG MORI – LIFECYCLE SERVICES**  
On the way to becoming a Service Champion ..... 20

**CUSTOMER STORY – BENZ WERKZEUGSYSTEME**  
For Best Performance with CAM and turn & mill ..... 22

**CUSTOMER STORY – MÖNNINGHOFF**  
Perfect technology integration thanks to the  
exclusive technology cycle gearSKIVING! ..... 24

**ADDITIVE MANUFACTURING**  
Additive Manufacturing has  
revolutionised metalworking ..... 26

**CUSTOMER STORY – FEMEC AG**  
Additive support for machining ..... 32

**CUSTOMER STORY – MTU AERO ENGINES**  
60% increase in productivity... ..... 34

**CUSTOMER STORY – ANDRETTI AUTOSPORT**  
Cutting edge performance for Indy 500 victory ..... 40

**MEDICAL EXCELLENCE**  
Innovative solutions developed in partnership ..... 42

**CUSTOMER STORY – ÖSSUR CORPORATION**  
Automation, technology and quality  
for a life without limitations ..... 44

**CUSTOMER STORY – YDM CORPORATION**  
99.98% finished part quality  
in continuous 24/7 operation ..... 48

**MEDICAL**



**TECHNOLOGY EXCELLENCE CENTER SEEBACH**  
Decades of industry experience, pioneering  
technology and projects developed in partnership  
lead to customised manufacturing solutions ..... 42



**WORLD PREMIERE**

**NTX 3000**  
Best in class turn & mill – turnMASTER  
with 1,194 Nm and compactMASTER with 120 Nm ..... 63



**CLX SERIES**  
New: Counter-spindle for 6-sided complete machining ..... 50

**CUSTOMER STORY – SCHUNK GMBH & CO. KG**  
24/7 with 97% uptime – 5-axis milling  
and 5 µm positioning ..... 52

**EXCLUSIVE DMG MORI TECHNOLOGY CYCLES**  
60% faster by conversational programming ..... 54

**CUSTOMER STORY – SKF MARINE GMBH**  
Spare parts worldwide in 24 hours  
through mill-turn technology ..... 56

**DIE & MOULD – DMU 340 GANTRY**  
The latest benchmark in the gantry sector ..... 60

**CUSTOMER STORY – TALON INNOVATIONS**  
Precision + Service =  
Growth and Competitiveness ..... 62

**DMG MORI QUALIFIED PRODUCTS**  
Trust is good – DMQP is better ..... 64

**DMU 50**  
Bestseller – More than  
15,000 DMU 50 operational worldwide ..... 66

**HEIDENHAIN  
MULTI-TOUCH  
PANEL FOR ALL  
CMX V & CMX U  
MODELS**

..... 49



## WITH „DYNAMIC . EXCELLENCE“ INTO THE FUTURE

Automation, digitization, additive manufacturing, technology and service excellence as well as DMG MORI Qualified Products. These are strategic areas of innovation from DMG MORI. As a technology leader, we are a reliable partner for networked manufacturing of the future for you, our customers and suppliers. We pursue our ambitious goals with **dynamic**:

- + **CELOS** – with 10 new APPs // version 5 available from April 2018.
- + **ADAMOS** – we offer our customers the open, digital platform as an integrated digital solution.
- + **Holistic processes** – comprising additive and cutting manufacturing as well as technology excellence in our leading industries for maximum performance.

Our “First Quality” strategy and the “Customer First” program are two of our top goals in 2018. As world leader, we want to continue with **excellence** to be your service champion in the future!

- + **“Customer First”** – our MASTER spindles are now offered with a warranty of 36 months with unlimited spindle hours.
- + **“First Quality”** – now means more at DMG MORI than ever before: Quality without compromise.

As a “Global One” company, DMG MORI is innovative and networked into the future – with “Dynamic . Excellence”. DMG MORI is an agile group that unites the traditions of all of its companies worldwide. Progress for the wellbeing of future generations – this is our goal. We hope you will continue to accompany us as we strive toward achieving it.

**Dr. Ing. Masahiko Mori**  
President  
DMG MORI COMPANY LIMITED

**Christian Thönes**  
Chairman  
DMG MORI AKTIENGESELLSCHAFT

# TRADITION MEETS HIGH-TECH





### Long tradition

The road to Iga leads through forested mountain landscapes. Traditional Japanese houses and buildings dominate the urban view. The town of Iga itself lies in the Ueno basin in the west of the Mie prefecture. By Japanese standards, Iga is a small town with around 92,000 inhabitants. Nevertheless, it is famous around the world as one of the birthplaces of Ninjutsu. An imposing Ninja castle rises above the town as a witness to history.

### Fascinating machine tool engineering

However, there is little evidence to show that this region is also home to one of the largest and most modern machine tool factories in the world at the DMG MORI Iga Campus. The Iga Campus was opened in 1970 and has

---

## GLOBAL SOLUTION CENTER WITH 3,500 m<sup>2</sup>

---

since then developed into the largest factory in the DMG MORI Group. Together with the site located in Nara, Iga represents the Japanese pillars of the global DMG MORI production network.

### High-tech site covering 577,000 m<sup>2</sup>

Visitors from around the world are received in the prestigious Global Solution Center, which also houses the 3,500 m<sup>2</sup> DMG MORI Academy. Over 60 high-tech machines from all technology sectors are available there for customer presentations and technology development. The Global Solution Center is also the gateway to an immense site covering 577,000 m<sup>2</sup>, where various factories contribute to the big picture.

## MACHINES AT THE IGA CAMPUS

- + **Universal turning machines**  
in the NLX series
- + **Turn & Mill machines**  
in the NTX series
- + **Production turning machines**  
in the NZX series
- + **Vertical machining centers**  
in the CMX V, NVX, NV and NVD series
- + **Horizontal machining centers**  
in the NHX series
- + **5-axis milling centers**  
of the NMV and NMH generation
- + **Additive Manufacturing:**  
LASERTEC 4300 *3D hybrid*  
based on Turn & Mill machines

80,000 m<sup>2</sup> are also available for assembling all the high-tech machines. The air-conditioned factories cover 63,000 m<sup>2</sup>. Other buildings include spindle production with 10,000 m<sup>2</sup>, an in-house foundry covering around 3,800 m<sup>2</sup> and a hardening shop approximately 1,300 m<sup>2</sup> in size. The site also includes a hotel and supermarket. A company kindergarten will open in Spring 2018.

### 1,500 employees produce 3,000 high-tech machines each year

In total, Iga Campus employs 1,500 people. 250 of them work in design and development. Together, they all ensure that up to 3,000 high-tech, top quality machines leave the factory to head for customers each year.

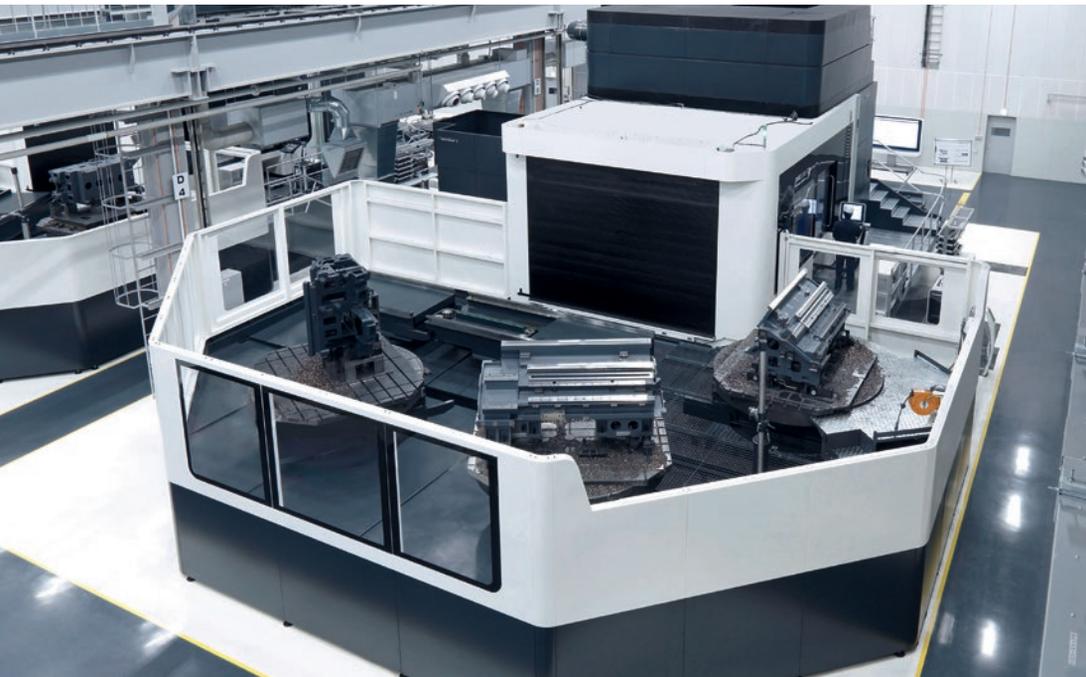
That is 62% of the total capacity of DMG MORI factories in Japan, which represent over 20% of the global DMG MORI production.

The Iga Campus export percentage lies just over 60% based on machines, and nearly 70% based on value.

## 250 EMPLOYEES IN DESIGN AND DEVELOPMENT

### Turn and mill centers are core products

Core competencies at the Iga Campus are the production of turning centers and milling machines, machining and component production. The NLX series universal turning machines, NT/NTX series turn & mill machines and the NZX production turning machines are all produced in Iga.



The automated machining of machine beds for the NLX series is carried out on three DMC 340 FD machining centers from sister plant, DECKEL MAHO Pfronten GmbH. Six older gantry machines were replaced with the three mill-turn centers.



A look at component assembly for the universal turning machines.



The Iga factory is characterised by a high level of vertical integration. This includes spindle production for the following series: speedMASTER, powerMASTER, torqueMASTER, compactMASTER and the turning spindle turnMASTER. Iga produces around 7,000 high-tech spindles a year.

## IN-HOUSE DEVELOPMENT OF COMPONENTS AND ORIGINAL TECHNOLOGY ALSO MAKE IGA CAMPUS UNIQUE

Further examples include vertical machining centers in the CMX V, NVX and NV/NVD model series, horizontal machining centers in the NHX series, the 5-axis machines NMV and NMH, as well as the new LASERTEC 4300 *3D hybrid* for additive manufacturing and metalcutting on a turn-mill platform.

### “Do It Yourself” at the highest level

DMG MORI produces the majority of quality-relevant parts at Iga Campus – ranging from machine bed castings right up to precision machining of those beds and housing components. Spindles, tool turrets, ball screws and  $\mu\text{m}$  range encoders are manufactured on site. Around 7,000 spindles are produced each year for the group’s global demand. The aim of this high level of vertical production is to safeguard and sustainably develop our quality and technological leadership in symbiosis with the innovative power of our developers and designers.

### “Scraping Dojo”

At Iga, there is great pride in the so-called “Scraping Dojo”. Experienced specialists use their finest dexterity to precision scrape machine guideways. Scraped sliding surfaces offer higher long-term accuracy. A scraped surface also ensures the formation of an optimal lubricating film due to the peaks and troughs measured at the  $\mu\text{m}$  level.

### Look back – into the future

The company Mori Seiki was founded in 1948 by three Mori brothers – Seiki is an abbreviation of the Japanese word for precision machines. Textile machinery was initially produced. Machine tools have been produced since 1958. The company was first managed by an uncle and then by Yukio Mori, the father of Masahiko Mori, who subsequently took over the top post in 1999 when he was 37. Masahiko Mori consequently drove the internationalisation of MORI SEIKI Co. Ltd. forward.

## ORIGINAL TECHNOLOGY FROM DMG MORI

### DMG MORI COMPONENTS

- + The **spindles in the MASTER series**, particularly the milling spindles speedMASTER, powerMASTER, torqueMASTER, compactMASTER and the turning spindle turnMASTER are available as of now with 36 months warranty with no limit on operating hours
- + One key technology at DMG MORI is called **BMT (Built-in Motor Turret)** and describes a turret with an integrated direct tool drive
- + **Directly Driven Motors (DDM)**, also produced 100% in-house, transfer the drive force to the rotational axis



»



In total, the Iga Campus site covers 577,000m<sup>2</sup>, incorporating various factories that contribute to the big picture.

#### “Global No 1 Company”

The cooperation, that began in 2009 with the then GILDEMEISTER AG was prophetic, looking at the company today. Success shows that this development was the right idea. As the “Global No 1 Company”, DMG MORI is the largest producer of metalworking machine tools and has become a pioneer in the industrial digitization of the manufacturing and mechanical engineering sector.

#### Everything – except ordinary

“If we were just an ordinary Japanese company, we would not have survived,” said Masahiko Mori recently. Today, as a “Global No 1 Company”, DMG MORI is everything – except ordinary.

## UPSWING AND DIGITIZATION

The Japanese machine tool market successfully got back on track in 2017. Companies invested primarily in automated production systems, while Industry 4.0 also gained in significance. In March 2017, the Japanese Ministry of Economy, Trade and Industry (METI) announced that the digital development of industry would in future be called “Connected Industries”. For DMG MORI, the “Path of Digitization” in Japan involves not only large companies, but is especially applicable to small and medium-sized metalworking companies, which are also the focus of digital production.



**HAIMER –**  
Your system partner  
around the machine tool

**HAIMER.**  
Quality Wins.

**DMG MORI**

TECHNOLOGY  
PARTNER



Tooling  
Technology

Shrinking  
Technology

Balancing  
Technology

Measuring and  
Presetting  
Technology

[www.haimer.com](http://www.haimer.com)



**DMG MORI**

TECHNOLOGY  
PARTNER



## Metalworking fluids from the specialist

For all materials.  
For all processing methods.  
For significant cost savings.

[www.fuchs.com/de/en](http://www.fuchs.com/de/en)

LUBRICANTS.  
TECHNOLOGY.  
PEOPLE.





**Dr. Naoshi Takayama**  
Senior Executive Managing Director,  
DMG MORI Co. Ltd.

# „FIRST QUALITY“ WITHOUT COMPROMISE

***Dr. Takayama, what integrated approach is DMG MORI following with its quality strategy?***

As a “Global No 1 Company”, we are aiming at the constant improvement of our product and service quality. Our quality standards are defined exclusively through the expectations of our customers and therefore greatly exceed “ISO 9000” requirements.

***Has your quality management changed since becoming the “Global No 1 Company”?***

The mingling of cultures and competence within the entire DMG MORI Group has given quality management many new ideas. The Production Problem Reports (PPR), for example, originated in Japan. They result from over 30,000 customer surveys that we carry out worldwide each year. If product-specific

machine failures are determined, the causes can be directly identified and preventative measures initiated.

In parallel, the “Quality Cockpit” developed by our German production sites has been phased in around the world. Employees now have easy access to all relevant quality data so that they can react at all times to problems in the product development process.

***How can these high quality requirements be standardised throughout all global production sites?***

All quality processes have been standardised across the group on the basis of Best Practice solutions created by the decentralised quality organisations. This has also been aided by the job rotation of numerous employees throughout the global production sites. Mechanical and electrical design has also been standardised.

Mandatory procedures have been implemented in parallel under our “First quality” initiative. These range from development, via design, test and process planning, right up to production and assembly. One such procedure sees each machine subjected to a 100-hour in-depth test before dispatch.

Each development is also accompanied by comprehensive Design Reviews. This applies from evaluation right up to approval by corporate management.

***DMG MORI is clearly intensifying in-house development of key components. Is this also a part of the quality strategy?***

We have the objective of developing and building the best machines in the world. Key components are therefore developed and produced in-house whenever possible.

One example of this is the MASTER spindle series, which combines the expertise of the entire DMG MORI Group. As a result, MASTER spindles are characterised by extreme reliability and a significantly longer service life compared to conventional spindles. This is why we now offer 36 months warranty on all MASTER series spindles – with unlimited spindle hours.

Other pillars of our quality guarantee include our long-term innovation partnerships and the DMQP certificate for peripherals and accessories. DMQP stands for DMG MORI Qualified Products. This seal of approval guarantees our customers the highest quality right down to the smallest of details.

***What role do your employees play with regard to quality?***

Our employees working in development, production and service are the heart of the entire project. The technical competence of each individual is decisive in promoting our “Quality First” philosophy and, above all, in actively implementing it. Constant further education and qualifications for our specialists are therefore a daily part of business at all our sites.



The MASTER spindles combine the expertise of the entire DMG MORI Group and are characterised by extreme reliability and a significantly longer service life.

*We now offer 36 months warranty on all MASTER series spindles – with unlimited spindle hours.*

Read more about it in the article on the following page.

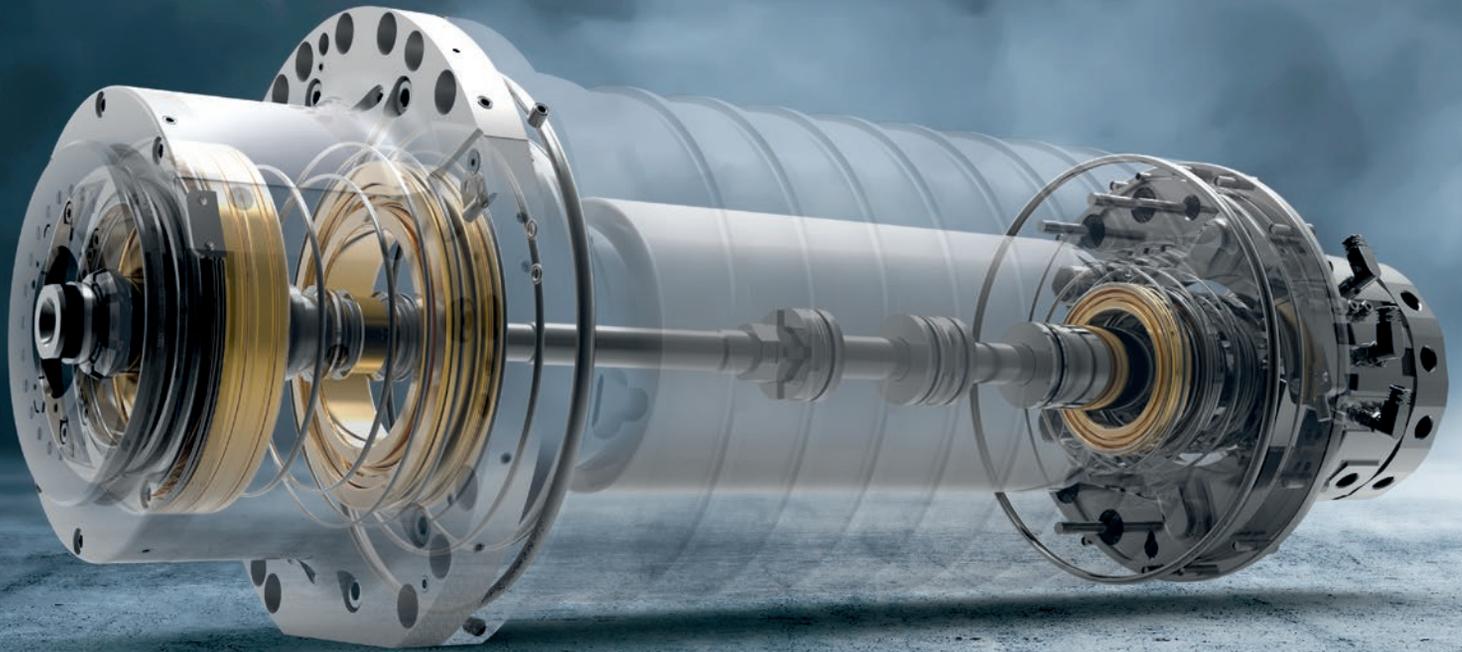


“Quality First” creates transparent processes with high repeatability. Comprehensive quality checks accompany the creation process from development to production.

# 36 MONTHS

WARRANTY FOR  
MASTER SPINDLES WITH  
UNLIMITED SPINDLE HOURS

NEW



The motor spindles in the “MASTER” series from the DMG MORI component portfolio now excel with a failure rate of less than 1%. By extending the warranty to 36 months the company has now officially declared these impressive benefits part of the programme.

As the interface between machine and tool, the motor spindles have an enormous impact on the precision and surface quality of workpieces. Their stability and long-term accuracy also have an immediate effect on the reliability and utilisation rate of machine tools.

#### Warranty with no runtime limitation

Reasons enough for DMG MORI not to leave anything up to chance: not in its own spindle production plants in Iga and Pfronten, nor from the point of view of the customer.

For all new orders, DMG MORI spindles in the “MASTER” series therefore have a 36-month warranty. “And what’s more, with unlimited spindle hours”, as Alfred Geißler, Managing Director of DECKEL MAHO Pfronten, stresses before going on to point out other design improvements. The rigidity of the spindles has been increased by 15% and the dynamic load rating improved by an impressive 30%. At the same time, thermal displacement has been reduced by 40% with true running accuracy enhanced from 5 to 3µm.

#### New performance promise for more than 95% of all DMG MORI machines

A glance at DMG MORI’s order statistics indicates the extent of the new performance promise. Over 95% of all the Group’s metal cutting machines are equipped with motor

spindles from the “MASTER” series. “The majority of these originate from our large production locations in Iga and Pfronten, where respectively 7,000 and 4,000 of these high-tech spindles are produced each year”, explains Alfred Geißler proudly.

#### Technology partnership as the basis of success

However, as an experienced technician he also stresses the importance of suppliers to the innovative DMG MORI production process. With regard to the “MASTER” spindles, he points in particular to the new spindle bearings from technology partner Schaeffler Technologies, which have opened up new possibilities for DMG MORI in the structural design of its motor spindles.



**Alfred Geißler**  
Managing Director of  
DECKEL MAHO Pfronten GmbH

**Kenji Oishi**  
Executive Managing Director,  
DMG MORI Co. Ltd.



#### New material for spindle bearings

The combination of a generously dimensioned bearing design with the high-performance roller bearing material Vacrodur is what makes these so special. Vacrodur has significant benefits compared to the traditional material 100Cr6, Alfred Geißler tells us. Its high hardness values of up to and even more than 65 HRC are especially outstanding. Overall,

this innovative steel exhibits extremely high load carrying capacity, resistance to wear and thermal stability.

#### New benchmarks in damage statistics

That is why Alfred Geißler is convinced that the current failure rate of 1% can be even further reduced with the new generation "MASTER" spindles. "Currently there are very few spindle failures and these are caused by wear, insufficient lubrication and contamination of the bearing. We will achieve new benchmarks with the Vacrodur bearings by improving all these issues."

«



DMG MORI COMPONENTS

## OVERVIEW OF MASTER SPINDLES

### MILLING SPINDLES

- + **speedMASTER 15,000** (SK40/HSK-A63)
  - 15,000 rpm // 21 kW // 111 Nm
  - 15,000 rpm // 46 kW // 200 Nm
- + **speedMASTER 20,000** (SK40/HSK-A63)
  - 20,000 rpm // 35 kW // 130 Nm
- + **speedMASTER Aerospace 15,000** (SK50/HSK-A100)
  - 15,000 rpm // 100 kW // 179 Nm
- + **speedMASTER Aerospace 30,000** (SK40/HSK-A63)
  - 30,000 rpm // 79 kW // 59 Nm

- + **powerMASTER 1,000** (SK50/HSK-A100)
  - 9,000 rpm // 77,5 kW // 1,000 Nm
- + **5X torqueMASTER** (SK50/HSK-A100)
  - 8,000 rpm // 37 kW // 1,300 Nm
  - 8,000 rpm // 52 kW // 1,800 Nm

### TURN-MILL-SPINDLES

- + **compactMASTER** (SK40/HSK-A63)
  - 12,000 rpm // 22 kW // 120 Nm
  - 20,000 rpm // 22 kW // 120 Nm
- + **compactMASTER** (SK50/HSK-A100)
  - 12,000 rpm // 36 kW // 220 Nm

### TURNING SPINDLES

- + **turnMASTER**
  - 6" chuck: 7,000 rpm // 11 kW // 70 Nm
  - 8" chuck: 5,000 rpm // 32 kW // 360 Nm
  - 10" chuck: 4,000 rpm // 26 kW // 525 Nm

# INTEGRATED DIGITIZATION SOLUTIONS



1. WORKPIECE  
SELECTION

2. PRODUCTION  
PLANNING

3. CELOS PC  
+ CAD/CAM &  
SIMULATION

## PLANNING

## PREPARATION



JOB  
MANAGER



JOB  
SCHEDULER



PRODUCTION  
PLANNING



PRODUCTION  
ORGANIZER



TECH  
CALCULATOR



JOB  
ASSISTANT



3D PART  
ANALYZER



TOOL  
HANDLING

# CELOS

# PATH OF DIGITIZATION

CELOS Machine  
CELOS Manufacturing  
DIGITAL FACTORY

# ADAMOS

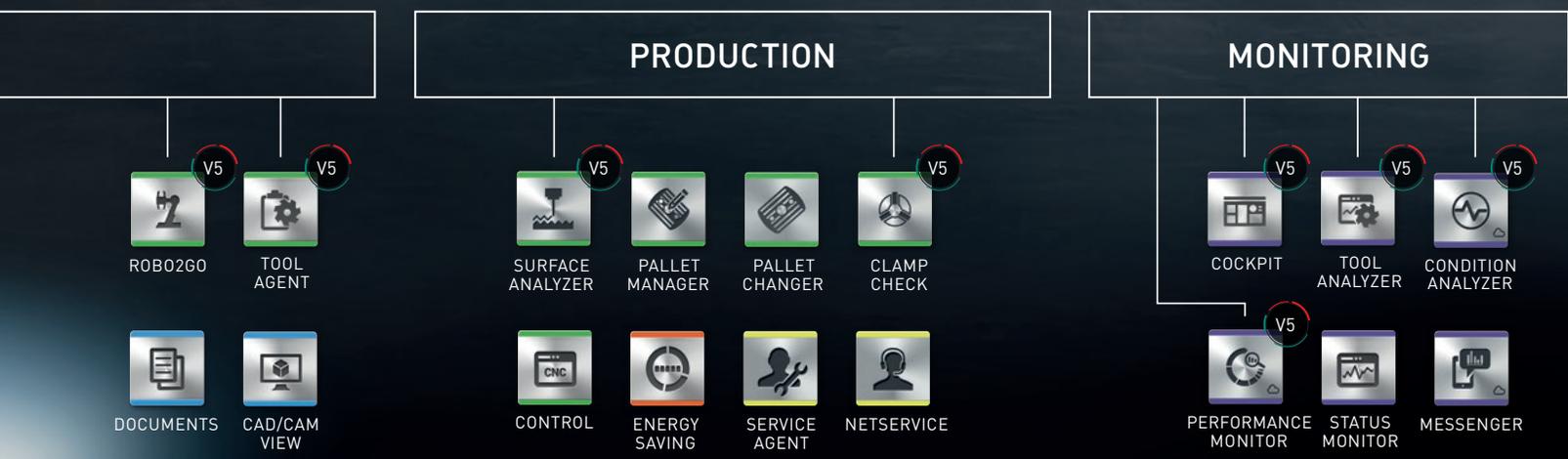


4. TOOL PRESETTING

5. MACHINE WITH CELOS 3<sup>rd</sup> GENERATION DMU 50

6. MACHINE WITHOUT CELOS CMX 800 V

7. CELOS COCKPIT



CELOS V5

26 CELOS APPS, INCLUDING 10 NEW



CELOS version 5 will be available as of April 2018

- PRODUCTION
- UTILITIES
- MACHINE VIEW
- CONFIGURATION
- SUPPORT



Find all information on our 26 CELOS APPs at: [celos.dmgmori.com](http://celos.dmgmori.com)

The topic Industry 4.0 continues to dominate machine tool building right through into the new year, with DMG MORI developing with ever growing momentum into a turnkey partner. CELOS, for example, offers a modular 360° solution portfolio for integrated digitization of a factory – of machines, processes and services.

**From strength to strength through digitization**

“What is the good of horizontal integration in digital value chains if the Internet-enabled ERP system knows nothing about what is going on in production?” Dr. Holger Rudzio, Managing Director of DMG MORI Software Solutions, does not ask this question without

good reason, because he sees the shop floor as the focal point of all digitization. In his view, the great benefit lies in the fact that digital transformation can be undertaken gradually, i.e. “bottom-up” instead of “top-down”, from the machining process to digital workflows and on through to the complete networking of the digital factory. One project after the other – and from strength to strength!

**Digitization “Toolboxes” for large and small manufacturers**

This perspective is reflected in the “Path of Digitization” that DMG MORI has declared as a mission statement for itself and its customers. It is a guiding principle that has recently been expanded enormously to include a multitude of digital innovations and pioneering projects. From January 2018 onwards, “digital factories” will be set up in the larger DMG MORI showrooms, where they will demonstrate live for customers the added value of horizontal integration.

Digital toolboxes are being created at DMG MORI through innovations and future-orientated initiatives. These will enable both a simple and harmonious entry into digitization for smaller companies while at the same time offering large companies integral and modular operability.

**Consistent digitization of workflows**

As of spring 2018, the focus of CELOS version 5.0 will be on end-to-end digital workflows – from planning to preparation and on through to production monitoring. The CELOS APP Package “Digital Planning”<sup>1</sup>, for example, enables efficient organisation of orders subject to the most diverse requirements. The Production Planning APP offers users the decisive advantage of more efficiency and reliability on the shop floor. According to Dr. Rudzio, the aim is the integrated connectivity of ERP systems, digital production planning and terminal-controlled shop floor manufacturing. “When combined with production planning, such consistency adds up to continuous process optimisation”, says Dr. Rudzio. This in turn reduces setting up and idle times and ensures a sustainable boost in productivity. Added digital transparency will also result in increased planning reliability.

“Digital Tooling”<sup>2</sup> is another workflow package. All tool information needed for the production process can be managed centrally with this CELOS APP package: NC programming and simulation as well as tooling, scanning and loading, whereby different systems can access the tool data simultaneously. In addition, all



**PRODUCTION PLANNING  
ADVANCED PLANNING  
& SCHEDULING**

**Christian Methe**  
Managing Director  
ISTOS GmbH  
christian.methe@istos.com

HIGHLIGHTS

- + **Intelligent planning** tool for production
- + **Higher transparency** for increased on-time production
- + **Optimisation** of throughput times and batch sizes
- + **Visualisation** of capacity reserves
- + **Planning** of maintenance
- + **BDE/MDE feedback**
- + **Interfaces** for transfer of orders from ERP systems



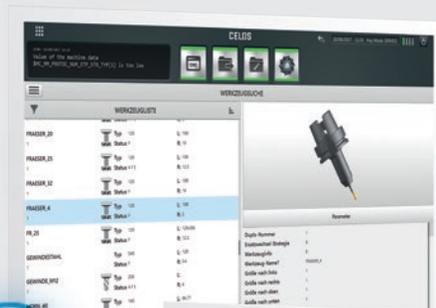
*“The APP Production Planning really kept its promise. The end-to-end connection of ERP system, Production Planning APP and shop floor control has enabled us to raise our adherence to delivery dates to a consistently top level”,* Achim Lübbering, Managing Director of Johannes Lübbering GmbH told us.

The company Johannes Lübbering GmbH, founded in 1986 with its headquarters in Herzebrock in East Westphalia, is a long-standing DMG MORI customer specialised in the production of fastening and drilling equipment for the automotive and aerospace industries. The family-run business with its more than 200 employees has been working successfully with DMG MORI’s PRODUCTION PLANNING for over four years now.

# DIGITAL TOOLING – THREE CELOS APPS FOR INTEGRAL DIGITAL TOOL MANAGEMENT

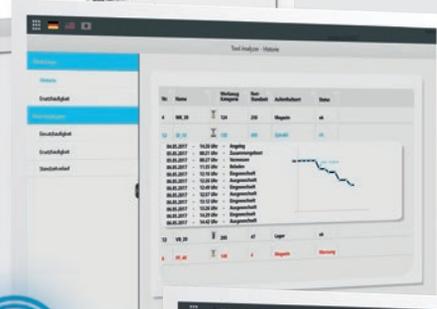


**Dipl.-Ing. Karl Doreth**  
Senior Product Manager CELOS  
DMG MORI Software Solutions  
karl.doreth@dmgmori.com



## TOOL AGENT

- + Generation and management of digital tools
- + Setting of tool parameters
- + Capture of presetting data



## TOOL ANALYZER

- + Analysis of recorded tool and process data



## TOOL HANDLING

- + Improved handling of physical tools (loading & unloading)
- + Identification and adaptation of digital and physical tools



process-related data are stored in a central tool management database, ensuring a transparent and seamless tool history.

### Monitoring with added value

To provide more transparency in production, the APP Package "Digital Monitoring"<sup>3</sup> visualises all key information of the digital factory. The CELOS APP Condition Analyzer offers the capture, storage, analysis and visualisation of machine sensor data. The CELOS APP then enables subsequent analysis of several machines, e.g. for early recognition of machine failures. The Performance Monitor also visualises current machine availability and efficiency independently of location. In

this way the CELOS APP creates transparency and control possibilities with regard to basic manufacturing parameters – so-called Key Performance Indicators (KPIs).

There are also a number of expansion options. With CELOS PROtab, DMG MORI brings a mobile assistant into networked production. DMG MORI customers will in future also use CELOS functions on older machines and machines from other manufacturers with the aid of this industrial standard. In addition, live images can be imported into chat conferences with the new serviceCAM in combination with the NETSERVICE 4.0 APP.

<sup>1</sup> Digital Planning enables end-to-end planning of production orders and includes the CELOS APPs Production Planning, Job Scheduler, Job Manager and Job Assistant.

<sup>2</sup> Digital Tooling realises integral tool management and includes the CELOS APPs Tool Handling, Tool Agent and Tool Analyzer.

<sup>3</sup> Digital Monitoring visualises all relevant process and machine information of a digital factory and can include the following CELOS APPs: Messenger, Condition Analyzer and Performance Monitor. Data from the APPs Production Planning and Tool Analyzer can also be visualised and the APP Cockpit can be used as the visualisation screen (dashboard) for all the APPs mentioned.

**Everything at a glance**

CELOS COCKPIT is the bridge between all machines in the production environment. This is where all shop floor-relevant information comes together, from both DMG MORI machines as well as third-party machines. It provides users with a holistic overview of the status on the shop floor – and, with the respective digital workflows from DMG MORI, even information about orders and failures (including bottlenecks, idle periods, causes and remaining runtimes).

As of April 2018, all DMG MORI machines with SIEMENS, HEIDENHAIN and MAPPS controls (except the SLIMline machines) will be available with CELOS version 5.0. Existing machines with older CELOS versions can be upgraded to the latest software standard.

The update to CELOS Version 5.0 is carried out by DMG MORI Service using an update stick. Data and communication settings remain intact. Every customer receives basic training in the new features when the new version is put into operation.

**ADAMOS facilitates turnkey digitization**

DMG MORI has implemented a key element of the CELOS digital factory with its digitization of the shop floor. To further expand digitization, DMG MORI has established the IIoT initiative ADAMOS in collaboration with partners from the fields of machine building and IT.

“ADAMOS is an important part of our “Path of Digitization”, because it allows us even greater freedom to determine and actively shape digitization ourselves”, is how Dr.Rudzio explains the strategic importance of the IIoT initiative.

**DIGITAL MONITORING – THE ENTIRE PRODUCTION PROCESS AT A GLANCE**



- V5 
- V5 
- V5 
- V5 

COCKPIT

+ **Visualisation of relevant machine data** from the CELOS APPs Messenger, Condition Analyzer, Performance Monitor, Production Planning & Tool Analyzer

MESSENGER

+ **Increase in productivity** through immediate detection of idle times

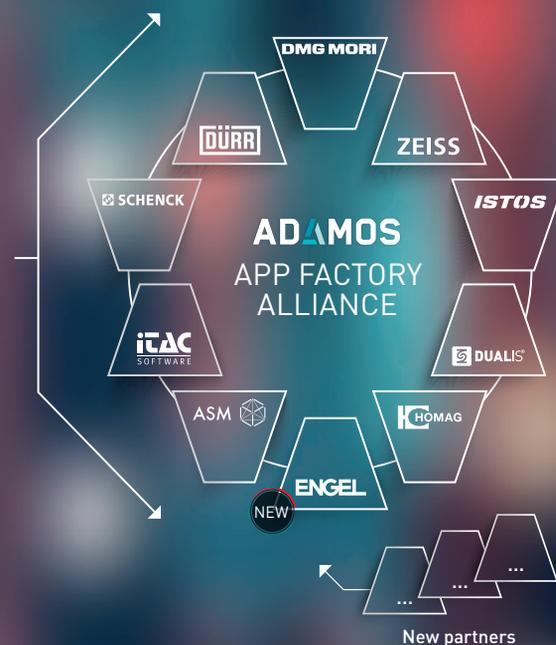
CONDITION ANALYZER

+ **Capture and analysis of machine data** with direct feedback for maximum machine productivity

PERFORMANCE MONITOR

+ **Location-independent capture, analysis and visualisation** of machine availability and efficiency through direct feedback from production

## ADAMOS IIoT-PLATFORM FOR THE MECHANICAL ENGINEERING INDUSTRY



With ADAMOS, CELOS is being developed into a digital marketplace so that DMG MORI can offer its customers integrated, digital and open end-to-end solutions for maximum security and transparency and efficiency in the digital factory.



**Laura Keller**  
Chief Marketing Officer,  
ADAMOS GmbH  
laura.keller@adamos.com

He compares the baseline situation with that of the PC world: "Where "Intel inside" is involved, we have ADAMOS – and where Windows operates on computers, we install CELOS." DMG MORI is working with strong partners, such as Dürr, Zeiss, ASM, Engel and Software AG in the ADAMOS initiative, with more partners to follow.

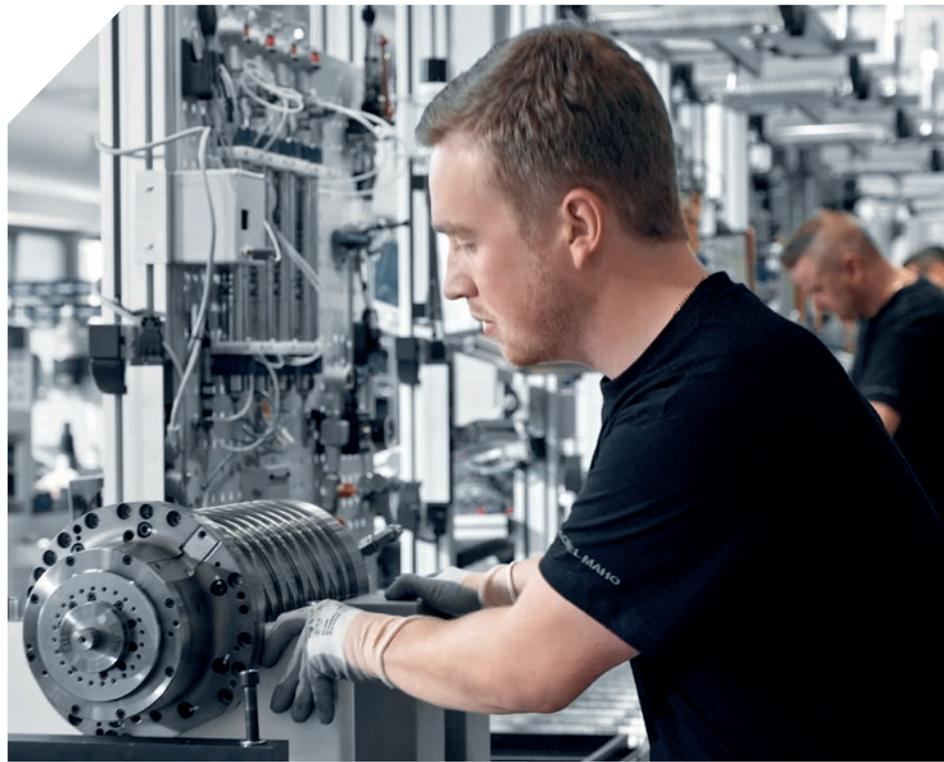
DMG MORI started off with a CELOS APP-based control and operating system. It is already possible to plan and visualise data-based processes completely from end to end in a factory with CELOS manufacturing. Thanks to ADAMOS, CELOS can now be developed into an open network and digital marketplace for the machine building industry. Dr. Rudzio sums it up: "We can now offer our customers digital services for all aspects of machines, we can digitize the entire production process chain and, thanks to ADAMOS, we can successfully design the processes for our customers integrally from end to end with a 360° approach!"

«

### ADAMOS – ADAPTIVE MANUFACTURING OPEN SOLUTIONS MECHANICAL ENGINEERING INDUSTRY SHAPES DIGITALIZATION

#### FACTS

- 1. Global Alliance:** DMG MORI, Dürr, Software AG, ZEISS, ASM and Engel pool their resources in ADAMOS for Industry 4.0 and are ready to welcome further partners
- 2. Open Platform:** The ADAMOS IIoT-platform is manufacturer-neutral, linking cutting edge IIoT technology and advanced industry knowledge
- 3. Broad App Portfolio:** The ADAMOS App Factory Alliance focuses on the technological expertise and industry knowledge of the partners for rapid joint development of apps
- 4. Digital Marketplaces:** The partners promote their digital competence to their customers and individual marketplaces under their own brand identities (for example CELOS powered by ADAMOS)
- 5. Strong Set-up:** ADAMOS GmbH and the ADAMOS App Factory Alliance launched on 1<sup>st</sup> October 2017 with around 200 experts, 5 digital marketplaces and more than 30 apps
- 6. End-to-End:** With ADAMOS, DMG MORI offers its customers, partners and suppliers a complete digitalization strategy



Spindle repair in the DECKEL MAHO plant in Pfronten.

# ON THE WAY TO BECOMING A SERVICE CHAMPION

## CUSTOMER FIRST 2.0 AND OTHER MEASURES FOR FASTER SUPPORT!

The LifeCycle Services are among the primary pillars of DMG MORI's future strategy. As early as 2016 DMG MORI made a clear commitment to customer orientation with "Customer First 1.0" and its 5 service promises. "Customer First 2.0" now sustainably expands this service commitment. An extensive increase in service personnel, among other things, will increase the availability and quality of our field service. In addition, new service products such as NETSERVICE 4.0 ensure even greater proximity to the customer and production efficiency.

**Core element of sustainable differentiation**  
Service is a particularly sensitive subject and problems in this area can quickly displease a customer, especially if the company

is operating at full capacity. As a member of the Executive Board Industrial Services DMG MORI, Dr. Maurice Eschweiler frankly admits that DMG MORI has also had some

### WE LISTENED CLOSELY TO CUSTOMERS

issues in this respect. "However, we have listened closely to customers and as a result have introduced targeted measures under the motto "Customer First" to sustainably improve our service offer – both mechanical and digital."

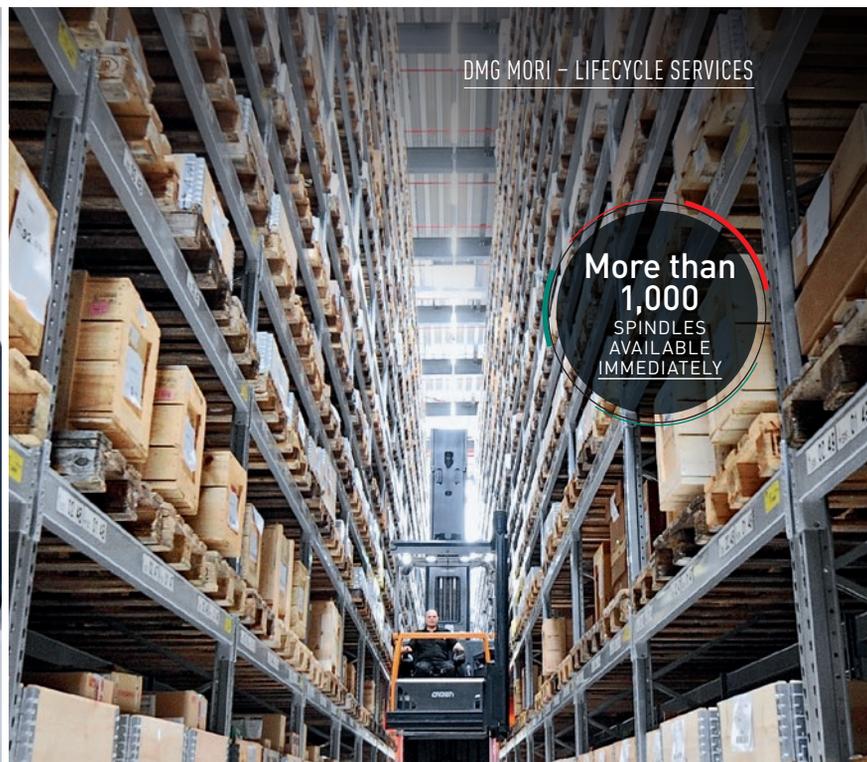
The second stage of the extensive service offensive was launched recently in the form of "Customer First 2.0". Service availability and possibilities for digitization are two special focuses of this new program.

#### **1,000 new high-tech machines a month**

Improving the availability of service takes top priority at DMG MORI. However, achieving this in times of dynamic growth presents a great challenge. There are, after all, more than 300,000 DMG MORI machines in operation around the world at the moment – many of these over 10 years old. And this installed base is rising by around 1,000 new high-tech machines every month.



One of more than 3,500 service technicians.



More than  
1,000  
SPINDLES  
AVAILABLE  
IMMEDIATELY

Spindle bearings in the DMG MORI Spare Parts warehouse in Geretsried: shipment possible within one hour, more than 122,000 spare parts in stock.

## 96% OF ALL SPINDLES ARE AVAILABLE WITHIN 24 HOURS

### Additional capacity for higher quality and shorter response times

That is why DMG MORI is gradually increasing the number of its service experts in the office and in the field. There are currently over 3,500 service staff working at DMG MORI. The intention is to strengthen the team of service specialists with an additional 200 people by

## 200 ADDITIONAL SERVICE EXPERTS

the end of the 1<sup>st</sup> quarter of 2018. DMG MORI has at the same time expanded its internal training and advanced training programmes enormously commensurate with the extensive product range and the technological demands from customers.

### World-class spindle service

This also applies where spindle damage is concerned. "The spindle is the heart of the machine, so service calls really put our team to the test", says Dr. Eschweiler, who is convinced that DMG MORI offers a world-class service in this respect. He proudly points out the more than 1,000 spindles that are held in stock. In other words at least 96% of all spindles are available overnight and can therefore be dispatched to the customer in the shortest possible time.

Based on the Customer First 2.0 initiative plus other developments in the field of digitization, Dr. Eschweiler sees the DMG MORI Service well on its way to being in a position to meet its own, and most especially its customers', high expectations without exception.



### ALWAYS READY TO HELP IF YOU NEED US:

We are available around the clock in emergencies. Experienced, highly qualified DMG MORI service staff are available for you 24 hours a day, 7 days a week via the 24/7 hotline.

## CUSTOMER FIRST 2.0

- + **Faster support:** 200 additional service specialists in 2018
- + **World-class spindle service:** 96% spindle availability
- + **NETSERVICE 4.0:** state-of-the-art remote service
- + **New Spare Parts pricing:** Best price guarantee for all spare parts



Jochen Tränkle (left), Team Leader of CAM-Programming; Marco Huber (center), Managing Director of BENZ; Manuel Göppert (right), machine operator on one of the four CTX beta TC Turn & Mill machines from DMG MORI.

# FOR BEST PERFORMANCE...

... IN SMALL-BATCH PRODUCTION THANKS TO THE ESPRIT SOFTWARE AND FOUR CTX BETA TC MACHINES FROM DMG MORI

**BENZ GmbH benefits from using CTX beta TC series turn & mill centers and the CAM system ESPRIT from the DMG MORI DMQP programme for the production of precision parts for its tool systems.**

As a leading supplier of components and systems for tool and machine technology, BENZ GmbH Werkzeugsysteme manufactures reliable CNC equipment and machine components. In development and production, BENZ benefits from the specialist expertise of its over 300 employees on the one hand and from state-of-the-art production equipment on the other.

Four turn-mill machines from DMG MORI have been installed among others since 2014, on which many different types of components are machined from small spindles through to complex housings. In addition, BENZ has installed ESPRIT from the portfolio of the DMG MORI Software Solutions as a CAM solution in order to further optimise the workflow – with the focus on turning.

“Almost every one of our workpieces presents a new challenge because they are mainly customised solutions”, explains Marco Huber, Managing Director of BENZ. As a rule the customer expects a design within one to two

weeks after placing an order, which will then be ready for delivery, including production and assembly, after six to eight weeks. Constantly changing workpieces also demands a high level of competence in production and above all flexibility. Marco Huber talks about single item production: “Our average batch size is two to three items.” As a consequence the machines have to be set up frequently. “We minimise this idle time by using a large tool magazine that ensures the time for tool replenishment is kept as short as possible.” Carrying out measurement during the machining process also saves time.

**Economical production with turn-mill technology**

Complete turn & mill machining also offers an opportunity to save time. "A CTX beta 800 TC, two CTX beta 1250 TCs and a CTX beta 2000 TC cover all component sizes in our programme", Marco Huber tells us about the company's machines. "Turning and milling in a single setup makes our production processes far more efficient and more economical. Thanks to the compactMASTER turn-mill spindle

TURN & MILL UP TO 120 Nm WITH THE compactMASTER

with up to 120 Nm, we achieve the same milling performance as on a machining center. The time saving is enormous in view of the high level of utilisation. BENZ operates over three shifts, allowing it to fulfil the large order book.

**Efficient CAM programming with ESPRIT**

A new challenge arose as soon as the four new machines were installed. Jochen Tränkle, team leader in CAM programming recalls: "The old CAM program did not work so well

with the new turn-mill centers." The post processor kept outputting faulty NC code. DMG MORI was able to offer a solution with its ESPRIT CAM software.

**Post processors certified for maximum reliability**

ESPRIT uses post processors certified by DMG MORI, which ensure an extremely reliable workflow and consistently correct output of NC codes. "Added to this is the wide scope of performance, especially for turn & mill machining", Jochen Tränkle goes on to tell us. ESPRIT aids workers in creating programs with special technology cycles such as Profit Turning, for example. This enables more efficient cuts with the same machining load and cutting forces, which in turn results in higher tool life and reduced cycle times.

"The software makes our work a lot easier, especially in view of the many new programs." says Tränkle. BENZ also benefits with ESPRIT where process reliability is concerned. "The CAM programs can be simulated directly on the PC so potential collisions can be avoided in advance", explains Jochen Tränkle.

This means they can minimise downtimes and maintain continuity of production. "It contributes a substantial part of process optimisation in metal removal", concludes Marco Huber.

Meanwhile, he and his team create almost all the NC code at central programming stations and download the programs to the machines. According to the team leader "Shopfloor programming is now only necessary in exceptional cases." This increases the utilisation rate of the production resource, which remains operational during offline programming.

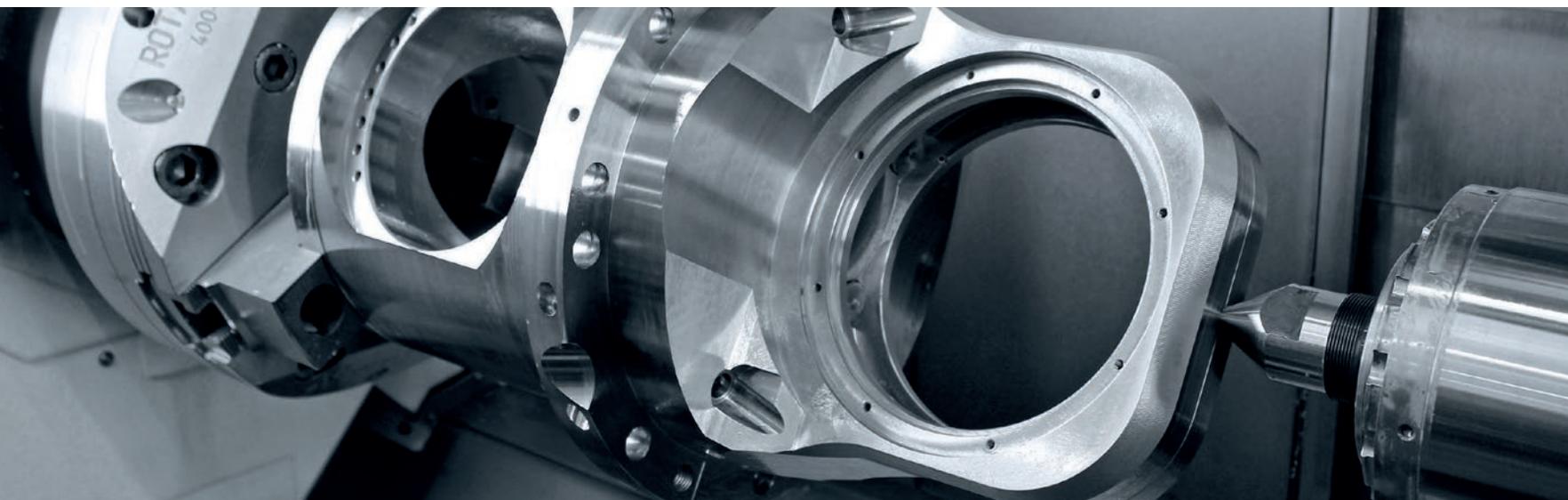
«

**BENZ WERKZEUGSYSTEME FACTS**

- + 1946 founded by Xaver Benz
- + Product programme:
  - powered tools for lathes,
  - exchangeable units (angle heads, multi-spindle heads, high-speed spindles), large-scale drill heads, controllable 5-axis heads, motor spindles, clamping tools



BENZ GmbH Werkzeugsysteme  
 Im Mühlegrün 12,  
 77716 Haslach i.K., Germany  
[www.benz-tools.de](http://www.benz-tools.de)



With every order BENZ develops and produces new components – from small spindles through to large complex housings.

# PERFECT TECHNOLOGY INTEGRATION THANKS TO THE EXCLUSIVE TECHNOLOGY CYCLE gearSKIVING! “ONE CTX BETA 800 TC REPLACES FOUR MACHINES”

**Timon Lubek**  
Production Manager at Maschinenfabrik Mönninghoff GmbH & Co. KG

CEO Kai Neubauer and Production Manager  
Timon Lubek in front of the CTX beta 800 TC.



DMG MORI gearSKIVING is one of currently 30 DMG MORI technology cycles for conversational programming. The programs can be created simply by inputting clearly structured parameters thanks to gearSKIVING. The cycle involves the production of gears using the power skiving process.

The machining of such components at Maschinenfabrik Mönninghoff GmbH & Co. KG used to be a lengthy and complex process carried out on four machines. The production process now takes place in a single setup on turn & mill machines from the CTX TX series. “The skiving procedure and optimal process harmonisation mean we are now significantly

more productive when it comes to idler gears,” Production Manager Timon Lubek tells us enthusiastically. “In addition, we can do without a complex (expensive) programming system thanks to DMG MORI gearSKIVING.”

Timon Lubek also wishes to stress the importance of the cutting tools: “Availability is a fundamental basis of success for us. This means every single tool must be designed ideally for the process and if a tool breaks, I need a replacement without delay. Sandvik is an outstanding tool supplier in both these respects and together with DMG MORI has developed to become an excellent partner.”

## MASCHINENFABRIK MÖNNINGHOFF FACTS

- + Technology partner for all aspects of drive technology
- + Worldwide leading supplier of high-precision switchable couplings, sensitive overload systems, optimised shaft couplings and linear drives for machinery and plant building

## Mönninghoff

Maschinenfabrik Mönninghoff GmbH & Co. KG  
Bessemerstraße 100  
44793 Bochum, Germany  
[www.moeninghoff.de](http://www.moeninghoff.de)



### Exclusive technology cycle DMG MORI gearSKIVING

- + Internal teeth possible without an angle head
- + Short machining times, up to 10× faster than gear shaping
- + Synchronisation of tool movement controlled by the cycle
- + CTX 5<sup>th</sup> generation, CTV DF, NTX and CTX TC up to module 4; duoBLOCK and Portal up to module 10; monoBLOCK up to module 8

More info at: [techcycles.dmgmori.com](http://techcycles.dmgmori.com)



### Sandvik Coromant CoroMill 178 & CoroMill 180

- + Internal/external gears and splines, spur gears with straight and herringbone teeth
- + Roughing and finishing
- + CoroMill 178 – HSS and carbide cutting – module 0.5 to 5
- + CoroMill 180 – indexable insert – module 2 to 8





# Need to lower your cost per part?

The global automotive industry is extremely competitive. High volume production and tight deadlines mean that your focus is probably to achieve an optimized and safe machining process, a high level of automation and an intense hunt for cost savings to lower your cost per part.

Sandvik Coromant can not only ensure the quality you demand, but also optimize your machining processes. Our comprehensive application knowledge, high quality tooling solutions and global support will help you get just what you are looking for, a lower cost per part produced with the right quality.

**Shaping the future together.**

[www.sandvik.coromant.com/automotive](http://www.sandvik.coromant.com/automotive)

**SANDVIK**  
Coromant

# ADDITIVE MANUFACTURING HAS REVOLUTIONISED METALWORKING

## INFINITE OPTIONS

- + **Conformal channels** offer revolutionary cooling options, e.g. for injection mould tools, minimising production cycles.
- + **Integrated channels** reduce heat load of highly stressed guide vanes in engine combustion chambers. This maximises efficiency and reduces fuel consumption.
- + Additive methods for producing crowns and bridges are already being used in **dental technology**.
- + Even the most **complex hydraulic or pneumatic valves** can be created flexibly with the minimum use of material.
- + **Functional prototypes** can be built overnight using series production materials. Development times are reduced by weeks or even months.

If there were any questions whether additive manufacturing in the metal sector could achieve the leap into industrial implementation, any doubts were answered at Formnext in November 2017. The future is almost within reach – also thanks to DMG MORI!

Various providers exhibited new machines and concepts at the fair in Frankfurt, in particular trendsetting machines and exhibits for future manufacturing. What also became clear when walking through the fair halls: as one of just a few manufacturers in this field, DMG MORI presented visitors with a large spectrum of options for further expansion of additive manufacturing.

As an additive pioneer, the company used integrated process chains to show manufacturers its process competence with both powder bed and powder nozzle technology.

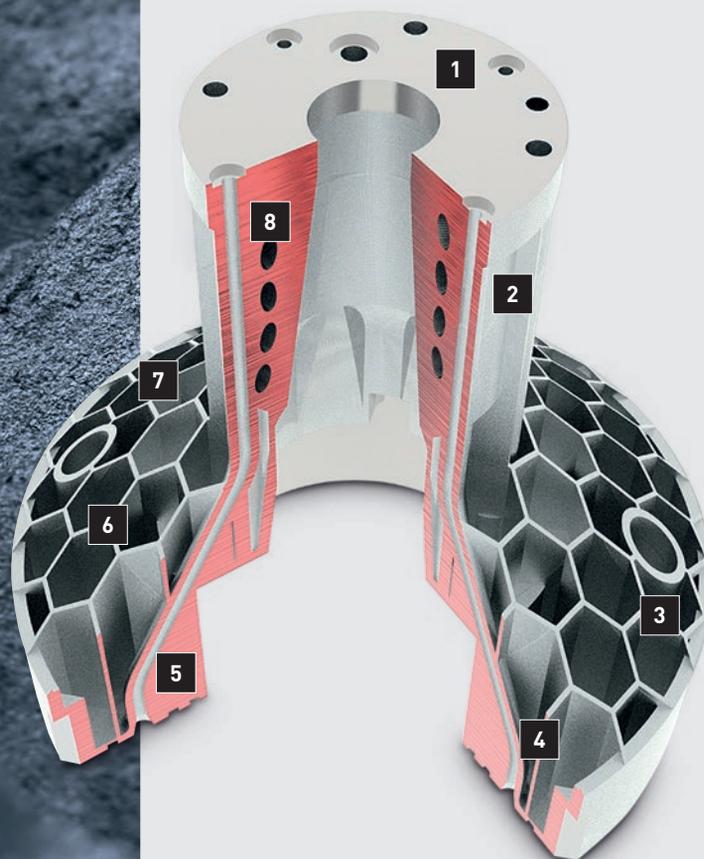
The starting point for this additive revolution is an extremely fine powder material with grain diameters of just a few  $\mu\text{m}$ .

## GLOBAL FULL-LINE FOR ADDITIVE MANUFACTURING

### ADDITIVE MANUFACTURING made by DMG MORI

With regard to systems, DMG MORI offers customers from one source two of the most significant current additive manufacturing methods for metal components. These methods have three continuous process chains, each based on machine technology and software, for powder bed and powder nozzle respectively.

»



#### 1. Agile product development

Product development is sustainably accelerated through the digital process chain from design to production

#### 2. Tool-less production

This production method enables significant reduction of production costs and time

#### 3. Functional integration

The increased surface area leads to improved cooling of the component

#### 4. Complex geometries

Sharp transitions, awkward features and negative angles can be produced that are almost impossible to achieve in any other way

#### 5. Work preparation

Optimal interaction of parameter optimisation and machine with the in-house developed RDesigner

#### 6. Integral design

This new design brings together 22 conventional components, seals and connectors

#### 7. Lightweight construction

Integrated honeycomb structure enables significant reduction of component weight while component stiffness remains almost unchanged

#### 8. Functional integration

Complex internal channels can be created to carry coolant and process gases, for example

LASERTEC 30 *SLM*

# PATENTED FOR BEST QUALITY

HIGHLIGHTS

- + **Additive manufacturing**  
with 300×300×300 mm build volume
- + **Application-specific fibre laser sources**  
from 400 Watts to 1 Kilowatt
- + **High precision building** of 3D parts with layer thicknesses between 20 and 100 µm
- + **Minimal operating costs:**  
only 70 l/h argon consumption
- + **Integrated powder recycling** for even more efficiency and improved powder handling
- + **Faster powder change**  
with exchangeable powder modules
- + **Complete software solution** with CELOS *SLM*  
from CAD file (RDesigner) to process control with a standardised user interface
- + **Optimal process chain** with post processing on DMG MORI HSC or DMU milling machines for absolute component accuracy and perfect surfaces



**Florian Feucht**  
Head of Sales and Application Technology  
florian.feucht@dmgmori.com



The LASERTEC 30 *SLM* enables additive manufacturing in powder beds with a build volume of 300×300×300 mm [X/Y/Z] – including powder preparation.

**LASERTEC 3D hybrid:**

**Finished part quality in one setup**

DMG MORI successfully entered the market four years ago with machines in the LASERTEC 3D hybrid series, which combine laser deposition welding and subtractive machining. This concept is used both in the LASERTEC 65 3D hybrid with additional 5-axis milling and in the LASERTEC 4300 3D hybrid combining laser deposition welding and 6-axis turning/milling. Both machines are designed for manufacturing comparatively large parts such as complex turbine components.

**Additive team player for the manufacturing industry**

DMG MORI has now uniquely upgraded its portfolio with these LASERTEC 3D hybrid machines, developing a complete range for additive manufacturing. While the LASERTEC 65 3D has been designed for pure laser deposition welding of larger parts, the LASERTEC *SLM* series has expanded the product range for the powder

bed method using selective laser melting. As additive team players, these two innovations combined with high-tech machines in the DMG MORI machining portfolio offer numerous options for full industrial processing.

**LASERTEC SLM: Revolutionary powder machine**

The LASERTEC *SLM* machines are the current highlight. In the powder bed method, a thin layer of powder is applied to a lowering platform. A continuous laser beam then melts the applied powder at the programmed positions in a cycle time of 10 µs.

Once all positions in one layer have been processed, the platform lowers according to the required layer thickness (between 20 and 100 µm). This process is repeated until the component has been fully built. When the completed workpiece is released from the powder bed, any excess powder falls through a mesh into a container for reuse.

**Holistic software solution for the powder bed method**

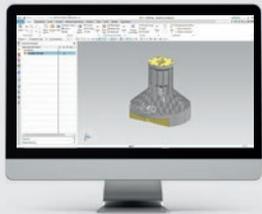
DMG MORI is also offering a comprehensive software solution with CELOS *SLM* for CAM programming and machine control in one package and with a standardised user interface. The tailored and standardised user interface can be used to program components – irrespective of their complexity – with minimum outlay and transfer the data immediately to the machine. Minor modifications can be made without retrograde steps and with the same user convenience directly on the machine control.

At the control level, CELOS *SLM* offers an adaptive exposure strategy that is automatically generated before the process starts. It ensures that the energy input into the component is so precisely controlled that no energy is wasted during the entire build process at scanning rates of approx. 20 µs. All process-relevant parameters such as scanning »

CONTROL

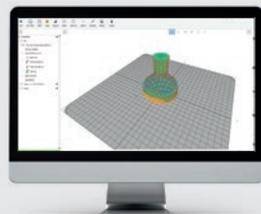
# WORKFLOW SLM TECHNOLOGY – PROGRESS OF DIGITIZATION

CELOS



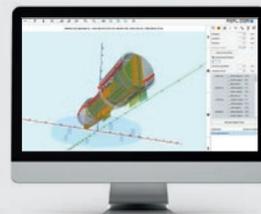
### CAD

- Starts with a pure CAD model
- + STEP
- + STL



### CAM-STANDARD

- + Orientation
- + Support
- + Slicing
- + Hatching
- + Copying



### HEAT CALCULATION

- + Advance calculation of mass distribution
- + Automatic adaptation of all laser parameters

### SLM-PROCESS

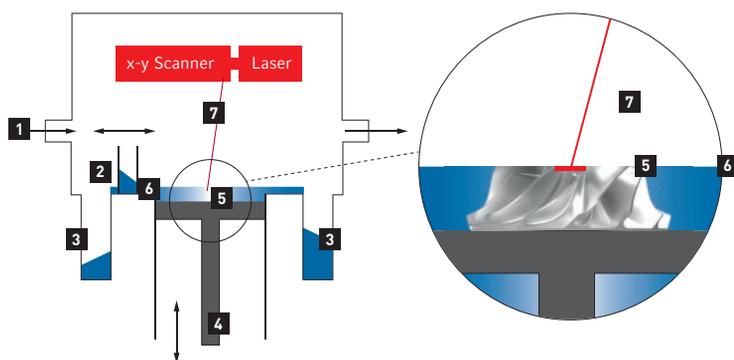
- + Perfect build through fully dynamic process

### MACHINING

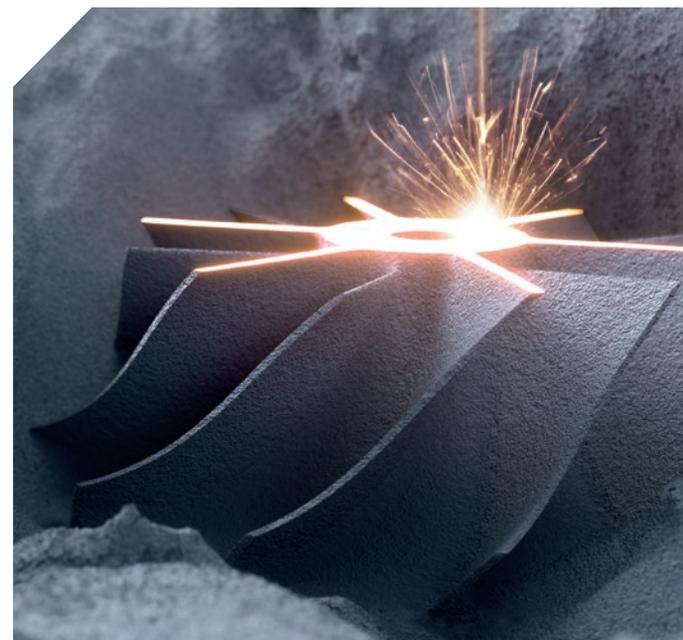
- + Direct data transfer for setting up the machining process

SLM PRINCIPLE

## POWDER BED FUNCTIONAL PRINCIPLE



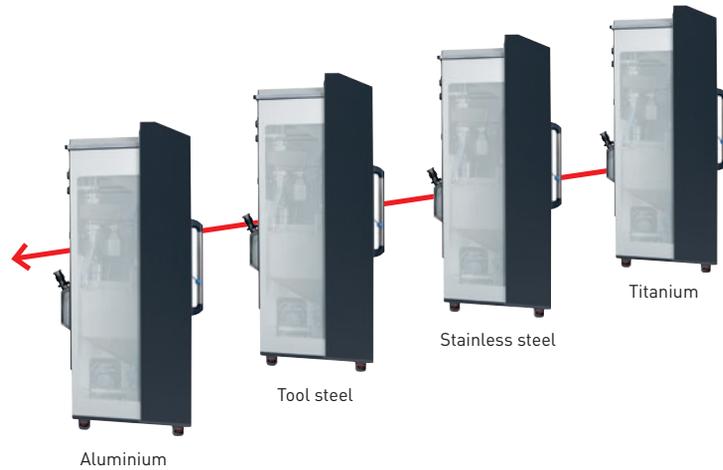
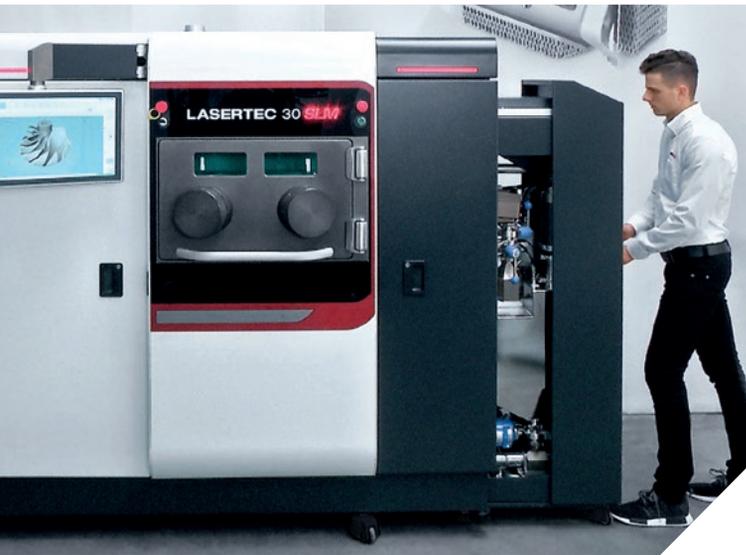
- 1. Inert gas [argon] 2. Recoaters 3. Powder containers
- 4. Lowering work platform 5. SLM component
- 6. Powder bed 7. Laser beam



The LASERTEC 30 SLM offers a build volume of 300×300×300 mm within which any workpiece shapes can be additively manufactured.

POWDER MODULE

# CHANGE OF MATERIALS WITHOUT CONTAMINATION IN LESS THAN 2 HOURS



Innovative powder handling system for material change in less than two hours:

1. **Cleaning the work area**  
to avoid entry of foreign material
2. **Insert and dock** the new powder module
3. **Start the LASERTEC 30 SLM**

speed, laser output and focus diameter are included in the programming process. Deformation and stress generation in the material are therefore prevented and even very thin horizontal or vertical walls can be safely generated.

### Quick-change module for powder change

A new powder module provides flexibility for order planning and high usage rates of the LASERTEC SLM systems. When changing materials, the work area must be carefully cleaned after the powder module has been undocked and docked so as to prevent entry of foreign material into the closed powder circuit. This has reduced changeover intervals between 2 powders from approximately 1.5 days to around 2 hours today and enables economic processing of different materials. <<

## MANUFACTURER-INDEPENDENT MATERIAL SELECTION

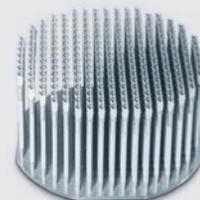
- + AlSi 10 Mg 0.5
- + CoCrMo (ASTM F75) for implants
- + CoCrMo for dental prostheses
- + Inconel 625
- + Stainless steel 1.4404 (316L)
- + Titanium TiLOP
- + Tool steel 1.2709



**Impeller:** Automotive,  $\varnothing 44 \times 27$  mm, Aluminium



**Blade:** Aerospace,  $70 \times 35 \times 110$  mm, Titanium

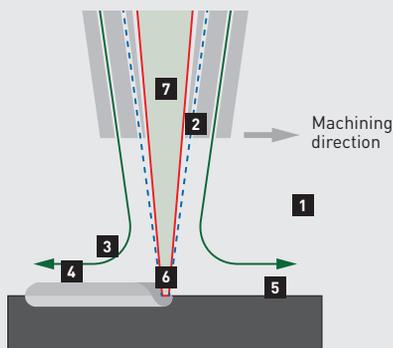


**Sensor:** Medical,  $\varnothing 2 \times 30$  mm, CoCr

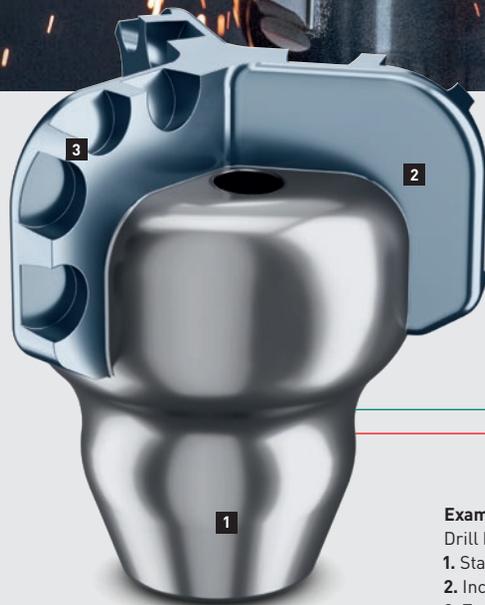
POWDER NOZZLE

# LASER DEPOSITION WELDING *3D/3D hybrid*

- + **Manufacture of larger workpieces:**
  - LASERTEC 65 *3D*:  $\varnothing 650 \times 560$  mm
  - LASERTEC 65 *3D hybrid*:  $\varnothing 500 \times 400$  mm
  - LASERTEC 4300 *3D hybrid*:  $\varnothing 660 \times 1,500$  mm
- + **High build rate**, averaging 750 g/h (steel, 90 cm<sup>3</sup>/h, LASERTEC 65 *3D*)
- + **Build layer, approx. 0.8 – 1.5 mm**
- + **Multi-materials and machining** existing workpieces:
  - Repair
  - Coating
  - Prototyping / manufacture



- 1. Inert gas
- 2. Powder
- 3. Applied material
- 4. Connection zone
- 5. Workpiece
- 6. Weld pool
- 7. Laser beam



- Example of multi-materials:**  
Drill bit/oil industry ( $\varnothing 150 \times 160$  mm)
- 1. Stainless steel
  - 2. Inconel
  - 3. Tungsten carbide

**SIEMENS**  
*Ingenuity for life*

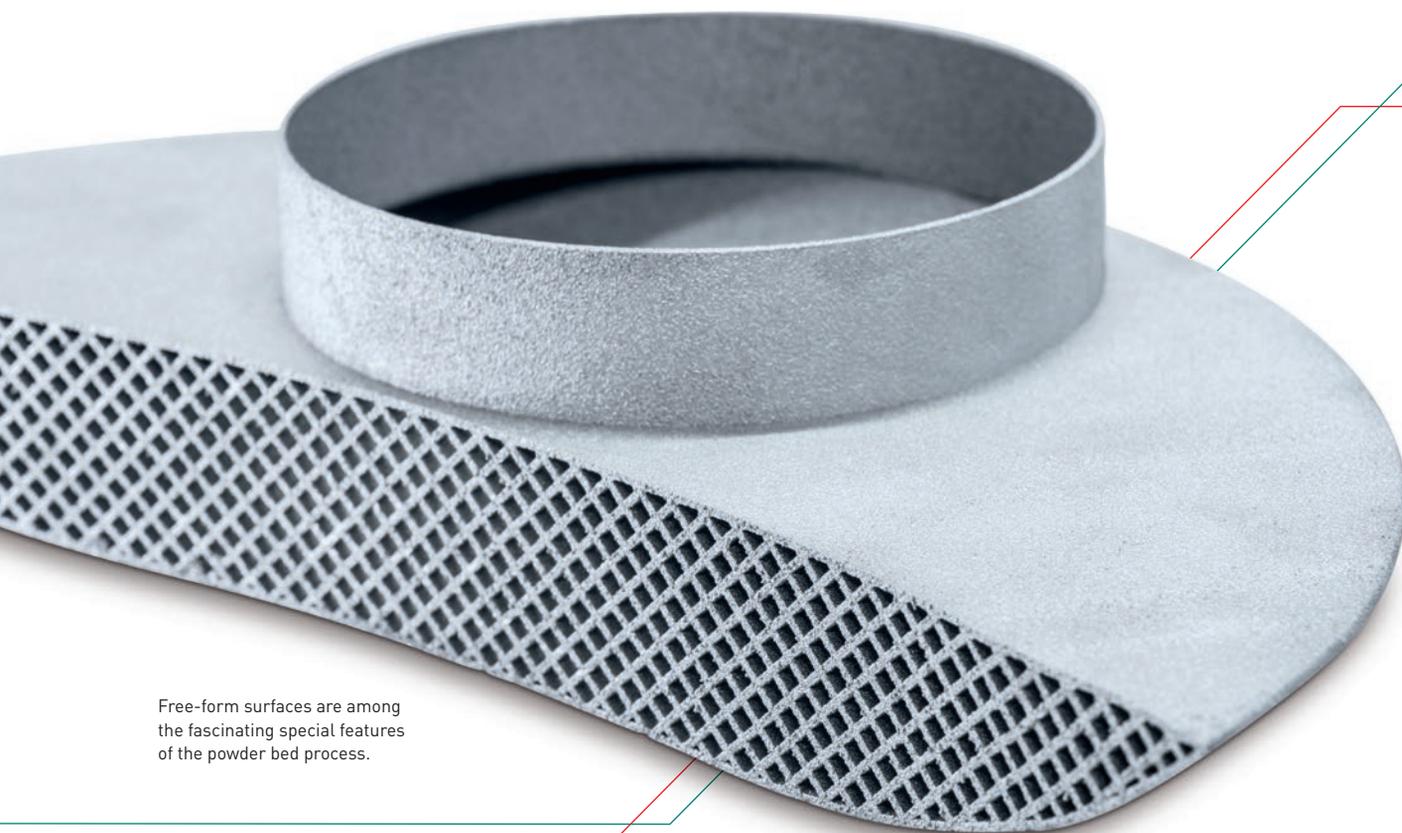
**DMG MORI**

TECHNOLOGY  
PARTNER

## NX Hybrid Additive Manufacturing

The integrated software solutions for Additive Manufacturing, incl. simulation and programming of Laser Metal Deposition and Laser Metal Fusion.

[siemens.com/plm/additivemanufacturing](https://www.siemens.com/plm/additivemanufacturing)



Free-form surfaces are among the fascinating special features of the powder bed process.

# ADDITIVE SUPPORT FOR MACHINING



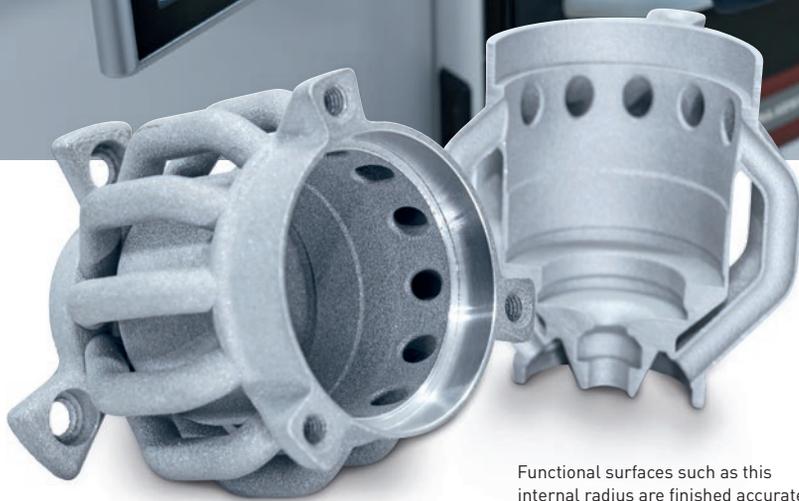
Second-generation Marc and Marlen Zimmermann manage Fmec AG

Fmec AG from Wetzikon in Switzerland has been active in additive manufacturing since 2014. A LASERTEC 30 *SLM* from DMG MORI recently expanded the company's metal component production.

For Marc Zimmermann, 2<sup>nd</sup> generation CEO of Fmec, additive manufacturing has become a differentiating core competence that has significantly enhanced the main business of metal cutting. After all, 3D-printed blanks normally have to be finish machined, says Marc Zimmermann.

#### Integral digitization of the additive process chain

Marc Zimmermann sees the digital process chain as key to the successful implementation of additive manufacturing. The solution at DMG MORI is called CELOS *SLM*, which receives special praise: "Both the intelligence of the integral system and its consistently uniform user interface – from the CAD file through to process control – really impressed us," stresses Marc Zimmermann. The reason for this he goes on to explain is that every new component constitutes a new project, which



Functional surfaces such as this internal radius are finished accurately in a final machining process.

Femec uses the integral software solution from DMG MORI consisting of RDesigner on the PC and the machine plus the ROperator for process control.

has to be developed in detail with regard to the material and the process. The quality of the workpieces is to a great extent therefore a question of the company's own expertise – but the better the support provided by the software, the better, faster and more reliably an incoming order can move on to production.

**Optimum powder handling in the LASERTEC 30 SLM**

With regard to the design features of the LASERTEC 30 SLM, it is the powder management that Marc Zimmermann finds particularly impressive. He points out the fast powder changeover in addition to the integrated powder recycling. "Thanks to the interchangeable powder module it takes us typically less than an hour for a complete powder changeover", claims the Production Manager.



« Filigree support structures and lattice structures are just two examples of the enormous freedom in design.

**FEMEC AG FACTS**

- + 1979 founded as a small machine workshop in Wetzikon
- + The range of activities includes machining and since 2014 also metal 3D printing in a powder bed
- + Approximately 35 employees
- + Core sectors: general machine and plant construction, automotive industry, medical technology



FEMEC AG  
Motorenstraße 6  
8623 Wetzikon, Switzerland  
[www.femec.ch](http://www.femec.ch)



## DMG MORI AEROSPACE EXCELLENCE CENTER

Thanks to over 20 years, experience in aviation and aerospace, DMG MORI supports numerous OEMs and suppliers with productive manufacturing processes, ensuring above average growth in the industry. All this competence and experience is bundled in the **DMG MORI Aerospace Excellence Center**. The result: excellent high-tech machines and production performance. Customers increasingly involve DMG MORI experts at an earlier stage in their future projects. Optimal production processes and complete turnkey solutions are enabled through this joint development, as was the case with the project for MTU Maintenance Hannover.

# 60 % INCREASE IN PRODUCTIVITY ...

## ... THROUGH ONE-HIT PRODUCTION AND TOOL REPLENISHMENT DURING MACHINING

**MTU Maintenance Hannover streamlined the repair of engine components in one setup thanks to cooperative process development and one-hit production.**

Aviation is booming: According to the International Air Transport Association, the annual number of flights has risen from 35 million in 2012 to almost 40 million – and no decrease in sight. The global fleet now encompasses almost 25,000 aircraft. Boeing forecasts that this figure will almost double over the next 20 years.

### **Strong growth in the MRO market**

This will directly affect MRO business for the maintenance, repair and overhaul of aircraft engines. The sector was worth almost 25 billion US dollars in 2015. The market is expecting this figure to grow to 46 billion US dollars by 2025. As a leading MRO provider, MTU Maintenance Hannover deals with constant growth in orders due to ongoing modernisation of machining processes, amongst other things. With impressive results: actual productivity has been increased by at least 60% with a DMC 210 FD from DMG MORI.

### **Up to 30 years aircraft engine service life**

Regular maintenance, repairs and overhauls are necessary to ensure that aircraft engines provide reliable service for up to 30 years. Andreas Kappe, Head of Industrial Services at MTU Maintenance Hannover, explained,

“Maintenance intervals are determined both by climate conditions affecting wear of highly stressed components and by strict safety regulations.” Economic factors are also decisive for airlines and leasing companies, as early maintenance can safeguard the value of the engine and therefore that of the aircraft.

### **Engine monitoring using Big Data**

An essential instrument in the MRO sector is data recorded by engines for subsequent evaluation or sent, where necessary, via the on-board computer to a ground station. Sensors measure exhaust gas and engine temperature, fuel and oil consumption, vibrations and pressure in the compressor, combustion chamber and turbines.

There are 5,000 parameters in total. One aircraft engine produces an average of one terabyte of data during one flight, an important source of information for the MRO process. According to Andreas Kappe, “Maintenance can be modified right down to the smallest details according to the actual requirements.” For instance, wear is higher in desert regions due to sand and dust.

All work on engines – which are usually delivered via Amsterdam or Frankfurt on special trucks – starts with an incoming test. This is followed by disassembly, cleaning and inspection of the components. Customised repairs are carried out, then the engine is reassembled »



L to R: Andreas Kappe, Head of Industrial Services at MTU Maintenance Hannover, acting CNC programmer Michael Seifert and Rafael Wilgoschesky, member of the project team responsible for the acquisition of the DMC 210 FD.

*The virtual machine reduces set-up and tool change times on the mill-turn center and facilitates order planning.*

**Andreas Kappe**  
Head of Industrial Services  
at MTU Maintenance Hannover

and subjected to a test before it heads back up into the air. This usually takes two to four months. "We are constantly optimising this process to remain competitive," said Andreas Kappe. Ongoing modernisation of machining is essential in this respect.

#### **60% increase in productivity**

In this regard, 2011 was a special year. MTU Maintenance Hannover had thoroughly evaluated its machining processes and came to the conclusion that flexibility and capacity on the shop floor was no longer future-proof. Marcus Spatz in production planning remembers, "We also identified numerous qualitative opportunities for standardisation."

Together with his colleague, Stefanie Krefsiek, and CNC programmers Michael Seifert and Rafael Wilgoschesky, the project team had the task of finding a machining solution that met all requirements for productivity and quality. It was rapidly noted that standard solutions could not meet these requirements. They found a partner in DMG MORI, one who could support the complex project with help and advice, as well as appropriate machine engineering.

Retooling during machining and one-hit machining including milling, turning and grinding were essential. The result of this collaboration: the DMC 210 FD with a total of five pallets. "Tool replenishment during machining now eliminates the majority of downtimes that used to limit us," said Stefanie Krefsiek, comparing the work done now on the mill-turn center with the old procedures. The same holds true for complete machining: "Up to five machines were necessary for some repairs, as well as time-consuming re-clamping operations for very complex components. We were able to increase our overall productivity by around 60%."

Complete machining in one clamping also represents a significant gain in quality. The productivity of the DMC 210 FD is so high that MTU Maintenance Hannover also uses this machine for comparatively smaller components of less than 1,000 mm diameter. The maximum travels of 2,100 mm in the X and Y-axes, together with the workpiece height of 1,250 mm, were also important criteria for the MRO specialists. As Andreas Kappe emphasised, "We only service medium to large-sized aircraft engines, so we need a large working area."



MTU Maintenance Hannover uses the large working area of the DMC 210 FD for a broad component range.

## THE ADVANTAGE FOR ENGINE COMPONENTS

Rotary magazine for tool replenishment during machining (5 pallets in total)

- + Special pallet changer for setting up over-size workpieces up to 2,600 mm in diameter
- + Vertical milling heads, including tool measurement in working area
- + Coolant system up to 80 bar with temperature control for absolute accuracy
- + Filtration down to 3 µm for the integrated grinding process
- + Integrated process monitoring for coolant pressure, flow rate, spindle power, feed force, etc.

### Process reliability thanks to in-process measurements and 1:1 simulation

Everyone at MTU Maintenance Hannover is always conscious of the high quality and extremely expensive workpieces. Any one of these assemblies may be valued at up to two million Euros. "Mistakes are an absolute taboo", stated Andreas Kappe. Marcus Spatz referred to in-process measurement as an effective tool.

## 1:1 SIMULATION FOR 100 % PROCESS RELIABILITY

### DMG MORI Virtual Machine

Additional security is offered by DMG MORI Virtual Machine, which has been used for some time now by MTU Maintenance Hannover. It integrates machine geometry, kinematics and dynamics, together with all NC and PLC functionalities. Michael Seifert enthused, "Our programs now run with absolute process safety." He added, "Working with this virtual machine also reduces set-up and tool change

times on the mill-turn center and facilitates order planning, as we can calculate cycle times accurately."

### Intelligent programming due to DMG MORI technology cycles

Other than in the production of engine components, material removal rates are very low during repairs. The aim here is instead to restore the component back to its original state. A metal plasma coating is applied to the damaged or worn area which is then machined back to the original dimensions. Accuracy, particularly for turned parts, lies in the µ range, which also explains the comprehensive measurement procedures.

For example, the machine checks the alignment of the workpieces before machining. Measurements for difficult to access features are carried out in-process with an L-measuring probe package. Intelligent NC programs use this data in real time. Michael Seifert said, "The machine measures the diameter of the component, for example, and only removes metal where too much material is present."



### Exclusive Technology Cycle Grinding – Milling

- + Grinding cycles for internal, external and face grinding plus dressing cycles
- + Machine-mounted sensors for wheel approach and dressing

More info at:  
[techcycles.dmgmori.com](http://techcycles.dmgmori.com)



DMG MORI TECHNOLOGY CYCLES & SOFTWARE SOLUTIONS

## ADVANCED PROGRAMMING AND ABSOLUTE PROCESS RELIABILITY

- + **Technology cycle – Grinding:** Internal, external and face grinding, and automatic dressing of the grinding wheel
- + **Technology cycle – MPC 2.0** – Machine Protection Control
- + **Technology cycle – Variation of spindle speed** for avoidance of vibration and chatter
- + **Technology cycle – L measuring sensor package** for measuring slots, grooves and diameters
- + **Special cycle** for incremental feed in X and Y
- + **DMG MORI Virtual Machine** – complete 1:1 simulation, incl. NC and PLC functionality for high process reliability

### Technology cycle – Grinding

- + Surface quality  $< 0.4 \mu\text{m}$  and  $< 5 \mu\text{m}$  concentricity
- + Quality 4 for  $\varnothing > 120 \text{ mm}$
- + Grinding cycles for internal, external and face grinding, dressing cycles
- + Machine-mounted sensors for wheel approach and dressing

This smart machining is the result of a steep learning curve that MTU Maintenance Hannover underwent in the programming department. Rafael Wilgoschesky looked back at this development, "We were optimally prepared after our training by DMG MORI, but the learning process still continues in practice." On the one hand, the SIEMENS controller offers innumerable opportunities for program optimisation. On the other hand, DMG MORI technology cycles significantly simplify and accelerate program creation.

"Speed variation can be easily programmed, for instance, with just three parameters to avoid vibration. We can also expand the processing scope of the DMC 210 FD with the DMG MORI technology cycle to include inte-

grated grinding." Andreas Kappe added, "The grinding process will be a central theme of the DMC 125 FD duoBLOCK to be installed here by DMG MORI in 2018."

### With modern technology into the future

MTU Maintenance Hannover has a positive view of the future, thanks to growth in its sector, but is also aware of the challenges. "New requirements imposed by the manufacturer are possible at any time." Andreas Kappe speaks from experience. DMG MORI successfully installed a new filter system for the DMC 210 FD recently because the engine manufacturer changed the requirements for coolant purity.

«

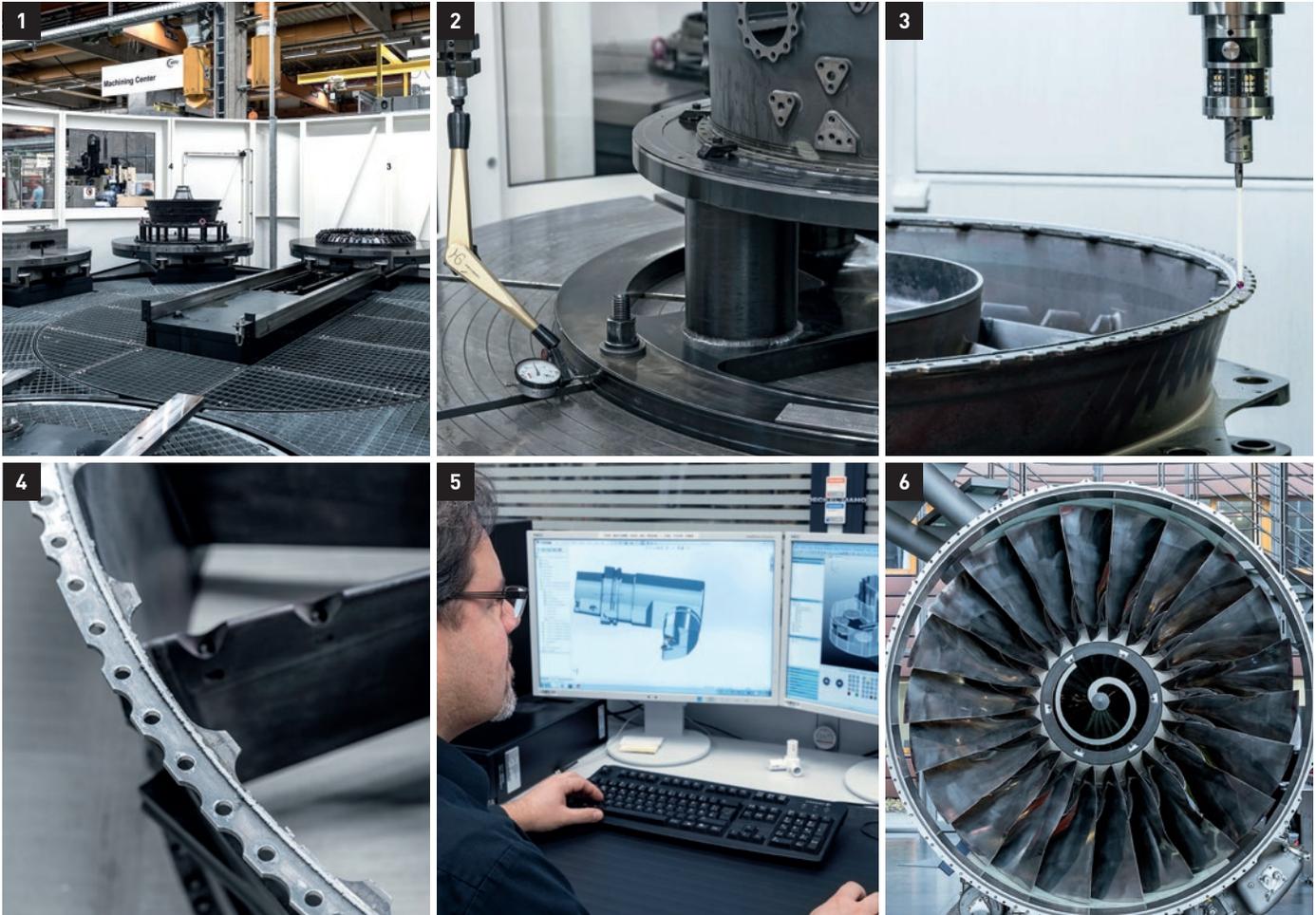
### MTU AERO ENGINES FACTS

- + MTU Maintenance Hannover: Tradition in the MRO sector since 1999
- + 2,100 employees on site
- + Services: Maintenance, repair and overhaul of aircraft engines (GE, Pratt & Whitney, International Aero Engines)
- + Aircraft engines work reliably and safely for up to 30 years with MRO measures



MTU Maintenance Hannover GmbH  
Münchner Straße 31  
30855 Langenhagen, Germany  
[www.mtu.de](http://www.mtu.de)





**1.** Tool replenishment during machining and a total of 6 pallets eliminates the majority of downtimes.

**2.** Concentric alignment of turned parts is carried out during tool change and then automatically checked on the machine.

**3.** In-process measurement to ensure accuracy in the  $\mu$  range.

**4.** A metal plasma coating is applied to the worn or defective area of an engine component during repairs so that the machine can subsequently restore the original dimensions.

**5.** MTU Maintenance Hannover is reaching almost 100% process reliability with the DMG MORI Virtual Machine.

**6.** Thanks to MRO, aircraft engines can now be reliably used for up to 30 years.

FIT FOR THE FUTURE  
WITH SINUMERIK

**SIEMENS**  
*Ingenuity for life*

**DMG MORI**

TECHNOLOGY  
PARTNER

[www.siemens.com/sinumerik](http://www.siemens.com/sinumerik)



**TOP SURFACE – PERFECT  
WORKPIECE SURFACES TOOL  
AND MOULD CONSTRUCTION**

- + Intelligent motion control
- + Optimal surface quality
- + Simple handling
- + Highest precision during milling
- + Faster interactions

**SMART OPERATE – SINUMERIK  
OPERATE OPTIMISED FOR  
MULTI-TOUCH OPERATION**

- + Intelligent zoom and scroll functions
- + Full control with gesture control and the proven operator interface of SINUMERIK Operate



# CUTTING EDGE

## PERFORMANCE FOR INDY 500 VICTORY

**Speed, precision and teamwork: Andretti Autosport relies on turning and milling technology from DMG MORI for demanding race car parts production.**

Founded in 2003 by Michael Andretti, Andretti Autosport knows well the thrilling feeling of being a champion – both on and off of the race track. The latest highlight: the 5<sup>th</sup> overall victory in the “greatest spectacle in racing” in Indianapolis, the legendary Indy 500.

The legacy of the name Andretti is based on three generations of racing history. Mario Andretti celebrated record victories in Italy. His son Michael later rose right to the top of the victory podiums in the USA. After ending his full-time racing career in 2003 he started the project “Andretti Autosport”. And now Marco Andretti represents the third generation active in motor racing.

Andretti Autosport is more than just a successful brand in motor racing. The name Andretti stands for a very special racing culture. With its long family history and incredibly successful record-breaking brands, the racing team places great importance on close

partnerships. Industrial passion and an aspiration to market leadership are united in joint projects – even on the shop floor.

That is also why Andretti Autosport chose DMG MORI as its official machine supplier back in 2010. Both brands embody their enthusiasm for technology, are drivers of innovation and market leaders in their fields. So it is no wonder that the technical partnership soon resulted in massive improvements thanks to the equipment from DMG MORI.

Altogether there are three machines installed at Andretti Autosport: the universal turning machine NLX 2500 SY | 700, the vertical



Example: High-precision valve seat for Andretti Autosport race cars, produced on the DMU 50 5-axis universal milling machine from DMG MORI.



For the production of its race car parts, Andretti Autosport relies on turn-and-mill technology from DMG MORI, namely (from left to right) the NLX 2500 SY | 700, a CMX 1100 V and a DMU 50.



Universal turning machine  
NLX 2500 SY | 700

machining center CMX 1100 V and a DMU 50. The DMU 50 in particular with its 18,000 rpm motor spindle opens up for Andretti innumerable possibilities for the machining of sophisticated components in a single setup, even through to 5-axis simultaneous machining. The vertical machining center CMX 1100 V with MAPPS on FANUC was installed just recently. Its large work area and a loading capacity of up to 1,000 kg enable the use of large multiple clamping devices. The NLX 2500 SY | 700 is used for 6-sided complete machining of complex race car parts. Thanks to the counter-spindle, Y-axis and BMT turret with 10,000 rpm, both turned as well as milled parts can be completely machined from all six sides. Common to all turn-and-mill applications is the demand for maximum quality and at the same time fast production times. Innovative cycles are developed every week

in both the lead up to the season and in the racing season itself. But unexpected damage just before the start of a race, where a spare part ideally has to be delivered to the race track overnight, also have to be mastered.

Scott Graves gives reassurance. "Highly stable DMG MORI machines offer us excellent quality and precision as well as a high degree of efficiency – plus excellent reliability as well" says the Engineering Operations Manager from Andretti Autosport. Added to this is the performance of the high-tech controls for fast programming and short setup times. That is why Scott Graves sees a clear competitive advantage in the complete DMG MORI package – because time is of the essence on the way to victory – on the race track as well as in the workshop.

#### ANDRETTI FACTS

- + Founded in 2003 by Michael Andretti
- + Indycar, Indy Lights, Global Rallycross and FIA-Formula E
- + 5x winner of the legendary Indy 500 in Indianapolis
- + DMG MORI official "Technical Partner" since 2010
- + Improvements in time and quality thanks to complete machining



**ANDRETTI**  
AUTOSPORT

Andretti Autosport  
7615 Zionsville Rd,  
Indianapolis, IN 46268, USA  
[www.andrettiautosport.com](http://www.andrettiautosport.com)



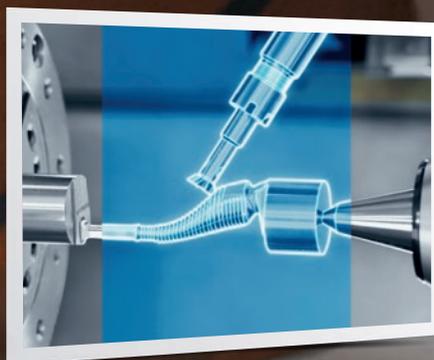
# MEDICAL EXCELLENCE CENTER



- + **Full-service provider for medical applications** in the fields of turning technology, milling technology, ULTRASONIC, LASERTEC and Additive Manufacturing
- + **Machining of the complete material range:** From high-strength plastic to stainless steel, from titanium to CoCr
- + **speedMASTER spindles** with up to 30,000 rpm or HSC spindles up to 60,000 rpm for unrivalled milling performance
- + **Workpiece-optimised automation:** Bar feeder, 6-axis robot or workpiece handling WH 3 for the MILLTAP 700
- + **Exclusive DMG MORI technology cycles,** 3D quickSET for absolute component accuracy, MPC 2.0 with cutting force monitoring for drilling and tapping



**Marcus Krüger**  
Head of Medical Excellence Center, Seebach  
[marcus.krueger@dmgmori.com](mailto:marcus.krueger@dmgmori.com)



Exclusive technology cycle  
**5-axis simultaneous machining**

- + Freeform surfaces with 5-axis interpolation at the main and counter spindles
- + Turning and milling with interpolating B-axis incl. ATC turning for increased machine dynamics
- + Look-ahead function for continuous machining, and intelligent motion control for perfect surfaces



More information:  
[techcycles.dmgmori.com](http://techcycles.dmgmori.com)

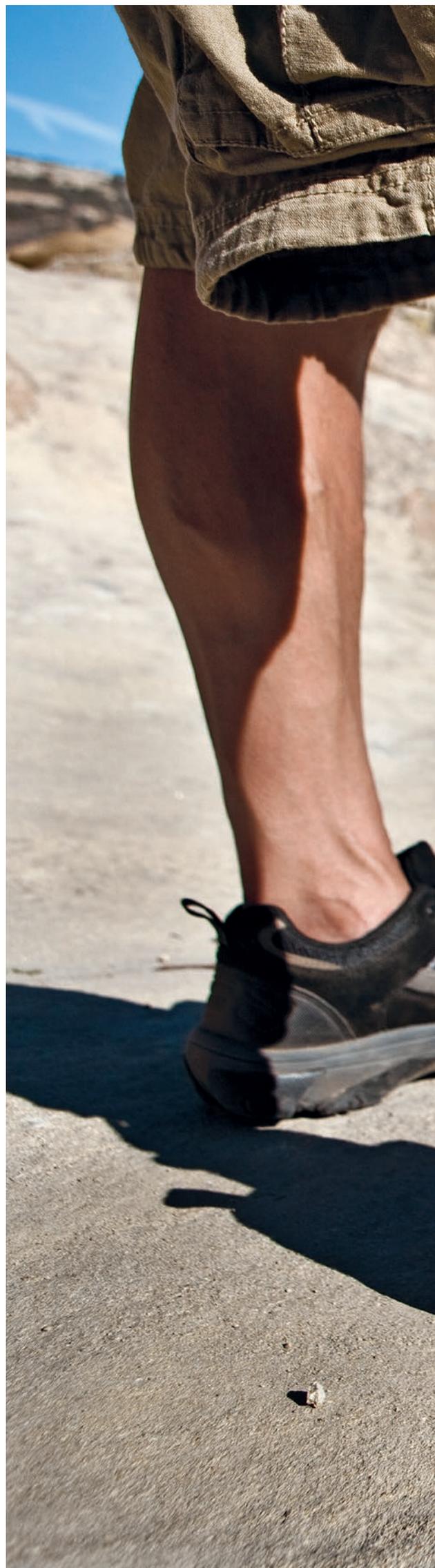
# AUTOMATION, TECHNOLOGY AND QUALITY FOR A LIFE WITHOUT LIMITATIONS

The Össur Corporation from Iceland produces complex components for state-of-the-art prostheses on a total of twelve turning centers and universal milling machines from DMG MORI.

As one of the world's largest and most innovative manufacturers of prostheses, Össur ensures that patients regain maximum mobility after undergoing an amputation. All its high value, premium products are used in medical applications, so maximum quality is essential in production. Össur meets these requirements in machining with high-tech machines from DMG MORI. The 25 experienced employees in mechanical production produce complex workpieces made of aluminium, titanium, stainless steel and plastic on eight turning centers, including two CTX beta 1250 TC 4A machines for turn & mill machining and three DMU 60 eVo *linear* universal milling machines.

Össur's claim – Life without Limitations – puts in a nutshell what Larus Gunnsteinsson, product designer, expects from the products: "With our products we wish to enable amputees to lead as normal a life as possible." That is why they do not regard themselves in competition with other manufacturers. "On the contrary, we are in competition with the human body."

A complete range of prosthetic feet for providing varying degrees of mobility resulted from the development work of Larus Gunnsteinsson and his colleagues – from occasional use for older patients to everyday use for active persons and on through to top-level competitive sport. Helgi Sveinsson, an Icelandic javelin thrower, the German long jumper Markus Rehm and the sprinter and long jumper Vanessa Low are just three of the prominent athletes who continuously achieve new records during the Paralympics and World Championships using Össur blades – as the carbon springs are called.





*With our products we wish to enable amputees to lead as normal a life as possible.*

**Larus Gunnsteinsson**  
Product designer at Össur

However, the main focus is on patients, who wish for as carefree an everyday life as possible. Larus Gunnsteinsson tells us: "We work consistently on optimising prosthetic feet so that their motion and roll-over behaviour come as close as possible to that of natural feet." Today's products have advanced enormously in this respect.

#### **Sturdy machines for maximum cutting performance**

While the carbon plates in the prosthetic feet support walking by storing and returning energy to the user, the silicone liners ensure fixed connection between the prosthesis and the limb as well as user comfort by reducing rubbing between the prosthesis socket and the skin. The rest of the prosthesis is made of very lightweight and at the same time sturdy aluminium, steel, titanium and plastic components that play a decisive role in ensuring the stability and reliability of the prosthesis and therefore also the mobility of the user.

So the Mechanical Department, in which Gunnar Eiriksson and Hrafn Davíðsson work as supervisors, is extremely important at Össur: "The production of complex workpieces requires high machining performance and sturdy machines." They found this combination a long time ago at DMG MORI.

»

1



2



1.–3. The stability and cutting performance of DMG MORI machines enable high-precision machining of the complex prosthesis components from aluminium, steel or titanium.  
4. Larus Gunnsteinsson, Product Designer



The prosthetic feet undergo extensive testing before they are released to the market.

The number of machine tools has expanded continuously and today includes twelve models. It is not only the three DMU 60 eVo *linear* machines that play a dominant role in production, but most especially the turning centers: three CTX beta 800 4A, two CTX 1250 TC 4A and two TWIN-models – forerunner of the current SPRINT-automatic turning machines. An NEF 400 turning machine and a DMU 60 monoBLOCK universal milling machine were installed in the development department. “We experience the stability of the machines every day, because our components are extremely demanding”, says Gunnar Eiríksson. Low-vibration machining enables efficient production of the high-precision parts – tolerances are often down to hundredths of a millimeter.

**Productivity thanks to automation and complete machining**

Efficient and above all productive manufacture is also necessary due to the fact that the demand is so high. “We process around 2,300 workpieces a day. Batch sizes are usually



3



4

between 500 and 1,000 parts”, explains Hrafn Davíðsson. Ongoing further development also results in new components continuously entering production. “Once a new design has been developed we can deliver the finished product within two weeks.” As a result the

## COMPLETE MACHINING FOR HIGH PRODUCTIVITY

production facilities are well utilised, from design and CAM programming to machining and on through to the measurement and anodization of the aluminium components. The team utilises the production capacity over two shifts a day and an unmanned night shift. This explains why the machines are automated. Magazines supply bar to the lathes and robots load the machining centers.

Complete machining is also a hot topic at Össur. That is why a lot of attention is paid in particular to the turn-mill centers in the CTX beta TC series, as Gunnar Eiríksson tells us: “We produce complex geometries on these models, which formerly had to be produced on two machines in several setups.” Without the need for manual reclamping, they boost quality and also provide impressive time savings. “Optimisation of throughput times takes top priority with us. Reducing machining time by just a few seconds has a great impact where larger quantities are concerned”, adds Hrafn Davíðsson.

### ÖSSUR CORPORATION FACTS

- + Since 1971 Össur has been a leading manufacturer of leg prostheses and silicone liners
- + 3,000 employees work worldwide in 35 locations
- + The company produces 500,000 prostheses a year
- + 150 tons of silicone a year are processed in the production of silicone liners
- + 100 tons of aluminium, steel, titanium and plastic are machined



Össur  
Grjóthals 1-5  
110 Reykjavík, Iceland  
[www.ossur.com](http://www.ossur.com)



# 99.98 %

## FINISHED PART QUALITY IN CONTINUOUS 24/7 OPERATION

YDM CORPORATION relies on milling technology and integrated automation solutions from DMG MORI for the production of precision pliers for orthodontic applications.

Quality is vital for suppliers in the medical sector. "For this reason, all machining steps in the production of our high-precision pliers are subject to stringent quality controls," stresses Nobuhisa Sakurai, General Manager



CMX V SERIES

### AWC WORKPIECE PALLET HANDLING SYSTEM

#### HIGHLIGHTS

- + 114-station AWC pallet storage for workpieces up to  $\varnothing 230 \times 150$  mm and 50 kg
- + Available as an option for  $\varnothing 350 \times 300$  mm, 80 kg; (number of stations on request)
- + For the NMV 3000 DCG or CMX 600 V with MAPPS

of the Development Division at the Japanese company, YDM CORPORATION. A rejection rate of just 0.02% makes the time and effort worthwhile.

Nobuhisa Sakurai sees permanently maintaining a high standard of quality as the great challenge of today, especially in view of constantly rising demand. This applies particularly to the machining of orthodontic pliers, which are made of martensitic stainless steel SUS420J2 (this corresponds to X30Cr13 in Europe). "It is a material that is difficult to machine because of its hardness", as Nobuhisa Sakurai explains.

#### Dynamics and precision in 5-axis machining

During production, YDM relies on extensive support from DMG MORI. Until recently the plier levers were completely machined to finished part quality on two NMV 3000 DCG vertical 5-axis precision machining centers.

Meanwhile a CMX 600 V with MAPPS control and a fully automatic AWC pallet changing system has been added to the milling equipment at YDM. The accurate connecting surfaces of the body of the pliers are milled in a 3-axis cycle, while the two NMV 3000 DCG centers now handle only the filigree tip geom-

etries of the precision pliers. Machines in the CMX V series from DMG MORI (available with SIEMENS, HEIDENHAIN and MAPPS controls) have ranked among the best-selling machines in this sector since 2015.

#### CMX 600 V with AWC workpiece pallet system

"The AWC pallet system of the CMX 600 V, with space for 114 blank and finished part pallets, offers sufficient capacity for 24/7 production," explains Toru Miyazato, Deputy Manager of YDM's Production Division. In addition to the high level of productivity and long-term accuracy of the production cell, the system also fulfils the highest demands for quality, as Keiichi Momiyama stresses: "The machining of the contact surface is the most important step with regard to the quality and ergonomics of the end product." Pliers consist of a left handle and right handle, of which one side is machined continuously for 2 to 4 days, after which the other side is subjected to the same treatment. Although they are machined at different times, both the sides meet the precision requirements. DMG MORI equips all CMX V centers optionally with the PH 150 pallet handling system for pallets weights of up to 150 kg or 250 kg and with a pallet change time of less than 40 seconds.

NEW

## HEIDENHAIN MULTI-TOUCH – THE NEW 3D CONTROL STANDARD FOR ALL CMX V AND CMX U MODELS

### MAXIMUM RELIABILITY

- + 3D control technology
- + Better overview thanks to 19" multi-touch screen
- + Better monitoring of the machine status
- + 45° pivoting of the panel for greater ease of operation
- + DMG MORI SMARTkey with 8 GB additional storage capacity

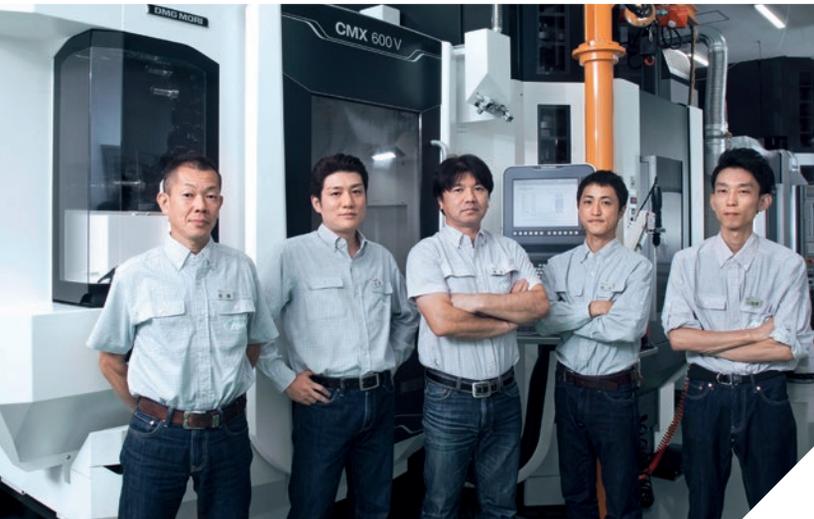
### MORE EFFECTIVE OPERATION

- + Fast and easy access to parameters and user data
- + Management & documentation of job order and process data
- + Efficient programming and data management incl. free contour programming, DXF import\* and look-ahead function\*

\*optional

### MORE USER CONVENIENCE

- + Simplified and more reliable operating process with complete also ASCII in the German version keypad
- + 3D simulation with convenient touch functions



The competence team of YDM in front of the CMX 600 V with a 114-station AWC and the NMV 3000 DCG (from left to right): Katsumi Sato (Manager, Production Division), Toru Miyazato (Deputy Manager, Production Division), Nobuhisa Sakurai (General Manager, Development Division), Keiichi Momiyama (engineer) and Hikaru Ogasawara (engineer).

### 200 % increase in productivity

Both the CMX V and the two NMV machines are in continuous 24/7 operation for 360 days a year. This has enabled an increase in overall productivity by a factor of 3. And with an eye to the future, Nobuhisa Sakurai explains: "Based on several new developments, we see great potential for considerable further strengthening of our performance by linking the CMX V with the two NMV centers."

«

### YDM CORPORATION FACTS

- + Leading manufacturer of dental equipment with a high level of competence in product development
- + High-speed precision machining of orthodontic pliers with CMX 600 V and NMV 3000 DCG
- + 24/7 production with the AWC-pallet changing system from DMG MORI with 114 pallet stations



YDM CORPORATION  
Headquarters: 6-5-20 Tabata,  
Kita-ku, Tokyo 114-0014, Japan  
[www.ydm.co.jp/en-new](http://www.ydm.co.jp/en-new)



### AUTOMATION

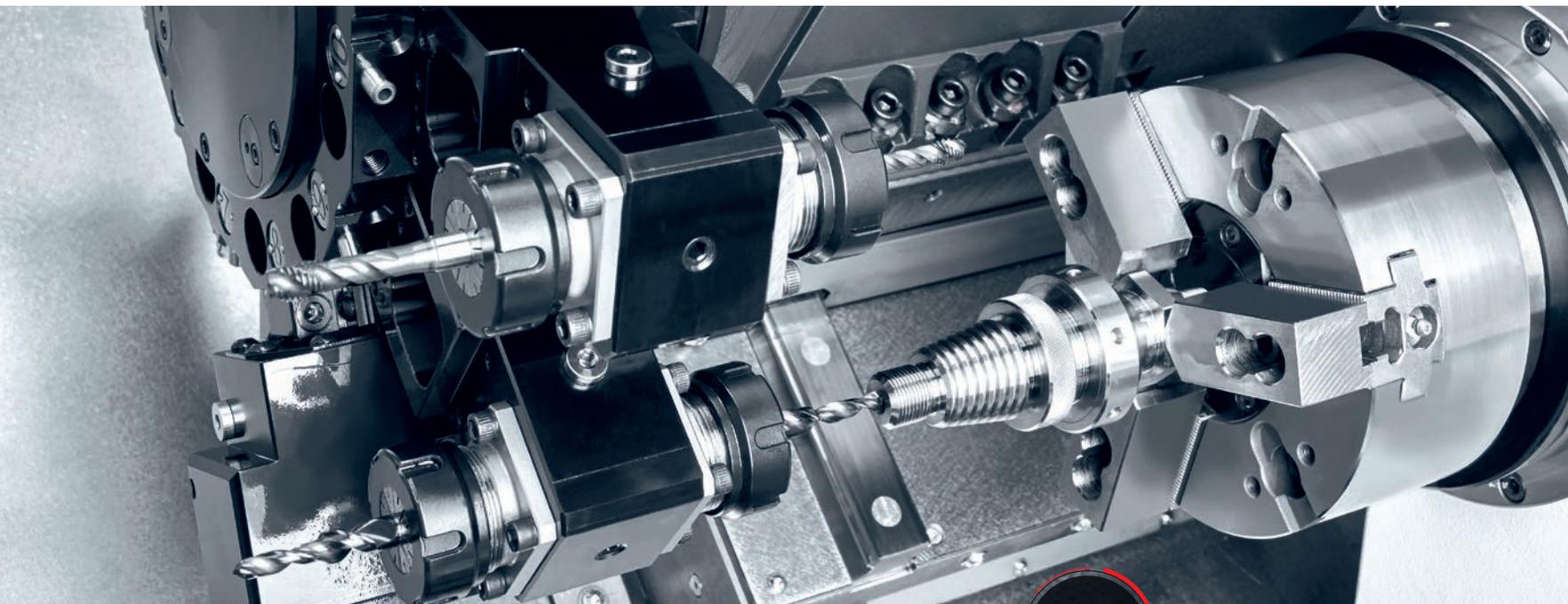
## PH 150 – THE INTEGRATED AUTOMATION SOLUTION FROM DMG MORI FOR ALL CMX V AND CMX U MODELS



CMX 50 U with pallet handling system PH 150

### HIGHLIGHTS

- + Max. load capacity 150 kg (250 kg as an option)
- + 10 pallets 320 × 320 mm, as an option 6 pallets 400 × 400 mm or 12 pallets ø210 mm, etc.
- + < 40 Sec. pallet change time



6-sided complete machining of complex workpieces thanks to counter-spindle and Y-axis with up to 120 mm stroke.

NEW



## COUNTER-SPINDLE FOR 6-SIDED COM- PLETE MACHINING

CLX 550

### < 3 μm CONCEN- TRICITY AND 630 Nm TORQUE

#### HIGHLIGHTS

- + **Heavy-duty machining** with main spindle up to 630 Nm and 33 kW (max. 3,250 rpm)
- + **6-sided complete machining** of complex workpieces thanks to counter-spindle and Y-axis with up to 120 mm stroke
- + **Impressive stability**, optimal for heavy-duty machining at the limit of the axis travels
- + **Linear guideways** for top precision and long-term accuracy
- + **Available with SIEMENS and FANUC**

The CLX universal turning machines in the DMG MORI portfolio of universal turning centers offer users totally new possibilities for complete machining. The CLX series is based on a modular solution for various sectors – including the automotive industry and general plant and mechanical engineering.

Modern CNC turning centers must be productive, flexible and easy to use, whilst dealing with a wide range of parts – a matter of course for the CLX series from DMG MORI. Evidence is provided by concentricity of < 3 μm, high axial and radial precision and a sturdy machine design for peak performance during heavy-duty cutting with up to 630 Nm of torque and at spindle speeds up to 3,250 rpm. The excellent fundamental attributes of the CLX turning centers can be upgraded to customer specifications. The CLX high-tech

modular system offers various hardware and software solutions, together with comprehensive technological options and DMG MORI technology cycles.

DMG MORI recently expanded the application range of CLX machines with variants having a Y-axis up to 120 mm for eccentric machining and a version with an additional counter-spindle for 6-sided complete machining.

Further highlights of the CLX programme are the numerous automation options – including the latest in-house development of the gantry handling system GX 8.

All CLX machines are also now available with 15" DMG MORI SLIMline control system and FANUC (alternatively to the 19" DMG MORI SLIMline Multi-Touch control system and SIEMENS).

«

SIMPLE  
AUTOMATION!

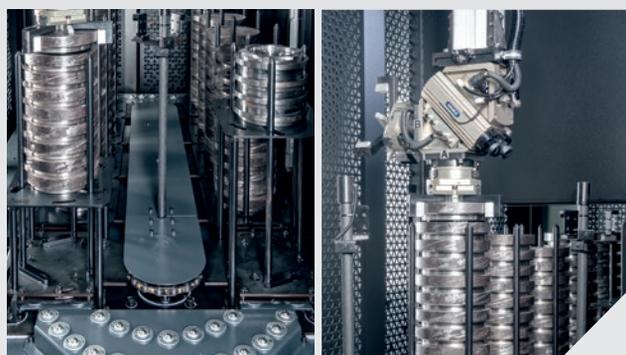


CLX 350 WITH GX 6

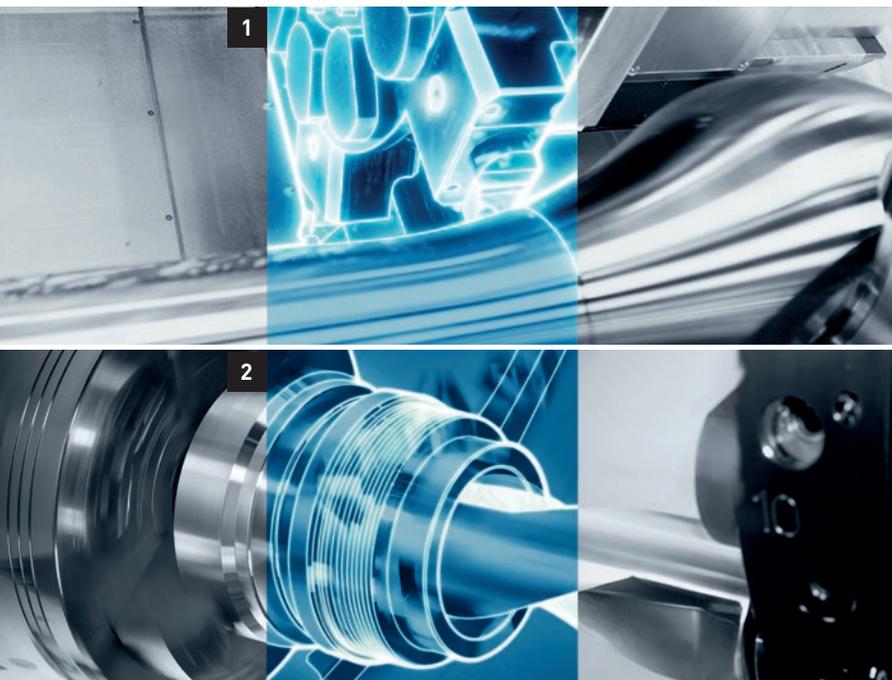
## GX – THE GANTRY LOADER FOR THE CLX SERIES

### HIGHLIGHTS

- + Fully automated gantry system with double gripper, incl. 3-finger centring
- + Workpieces up to  $\varnothing 200 \times 150$  mm and max. 6 kg 10-fold stacking magazine for workpiece storage (max.  $10 \times 70$  kg)
- + Optional telescopic arm for factories with low ceiling height
- + Simple programming and setup through integration in the machine control system
- + Measurement system for workpieces and tools



Unmanned production possible due to 10-fold stacking magazine (max.  $10 \times 70$  kg) for workpieces up to  $\varnothing 200 \times 150$  mm and max. 6 kg.



### DMG MORI technology cycles

1. **Variation of speed:** Avoidance of vibration and chatter by modifying the spindle speed
2. **Easy Tool Monitoring 2.0:** Avoidance of damage following tool breakage or tool overload

NEW

CLX NOW ALSO  
AVAILABLE  
WITH FANUC



### KEY FACTS CLX SERIES

Technical data		CLX 350	CLX 450	CLX 550
Max. turning length	mm	530	555	1,225
Max. turning diameter	mm	320/250*	400/315**	480/425**
Power (40% DC)	kW	16.5	25.5	33
Spindle speed	rpm	5,000	4,000	3,250
Turning spec.	V1	•	•	•
Milling spec.	V3	•	•	•
Y-axis	V4	•	•	•
Counter-spindle	V6	•	-	•

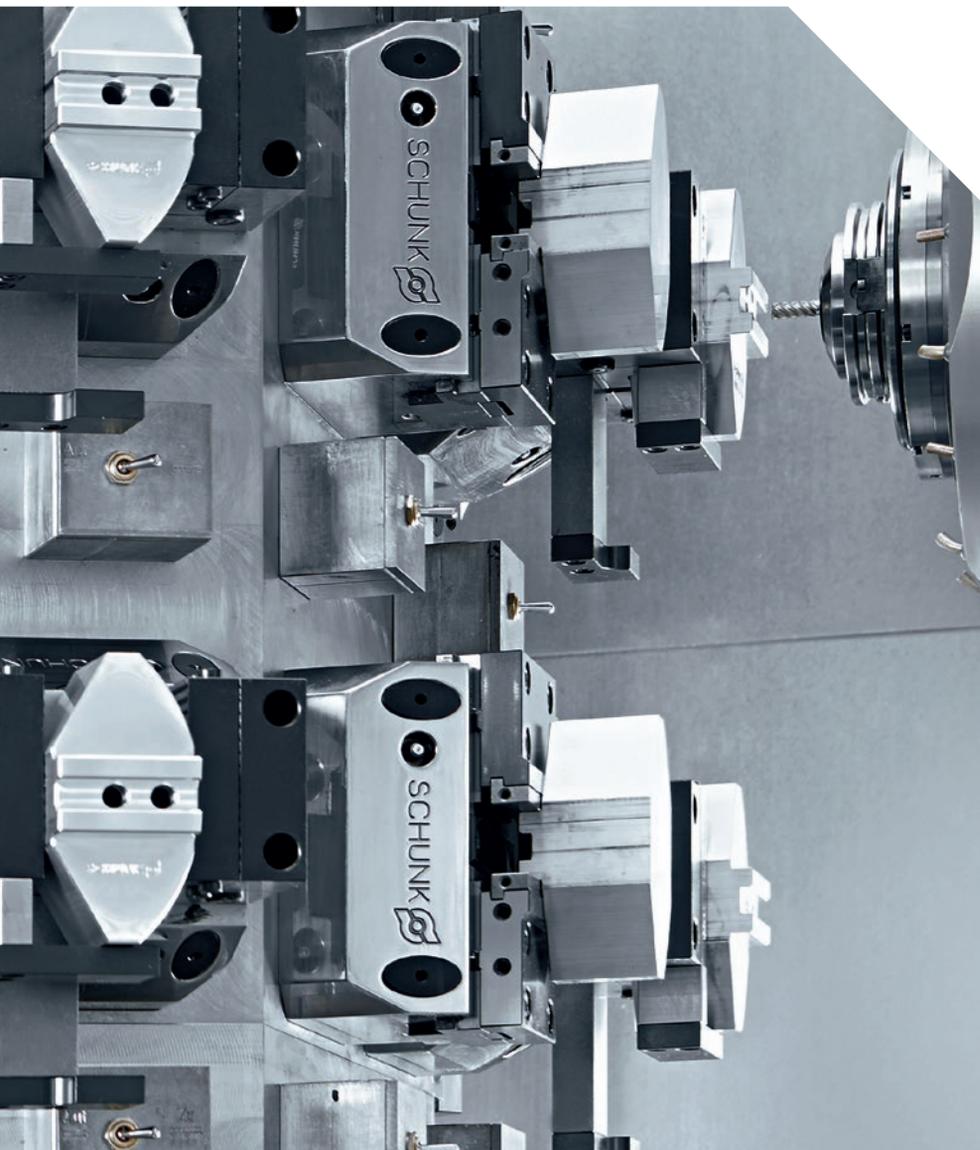
• available, - not available, \* recommended, \*\* Version V4 with Y-axis



You can find all information about DMG MORI automation solutions here: [automation.dmgmori.com](http://automation.dmgmori.com)

# 24/7 WITH 97% UPTIME

## 5-AXIS MILLING AND 5 $\mu$ m POSITIONING



**DMC 125 U duoBLOCK:**  
The large cubic work area enables the use of tombstones with up to 36 clamping positions.

**Pioneering paradigm shift at SCHUNK with automated 5-axis technology and mill-turn performance from DMG MORI.**

SCHUNK GmbH & Co. KG recently revolutionised the production of chuck jaws for lathes with not just one but two new manufacturing systems from DMG MORI. Instead of the former multi-stage production, all process steps are now carried out on two ultra-modern production units from DMG MORI. Maximum flexibility is guaranteed by the new 5-axis manufacturing systems with clamping technology specifically developed to enable the machining of 400 different types of workpieces. With a mill-turn machine, SCHUNK was able to reduce the throughput time for the production of special chuck jaws in a second project by 50%.

“A pioneer has the courage to take new paths” is a quotation from Heinz-Dieter SCHUNK, acting partner of SCHUNK, a producer of gripping systems and clamping technology headquartered in Lauffen am Neckar. With 11,000 products, the company offers the world’s biggest range of gripping systems and clamping devices and the most extensive programme of standard gripping components. Such diversity in its products demands flexibility in their manufacture.

It was exactly this point that threatened to stretch sequential production to its practical and economic limits. It took up to four clampings just for milling during soft machining. The result was long setup and idle times. That was why Johannes Ketterer, Manager of the Clamping Technology Division in the Lauffen plant and his team were searching for new production concepts.



With 11,000 products, SCHUNK offers the world's largest variety of gripping systems and clamping devices as well as the widest range of standard gripping components.

## HIGHLIGHTS INSTALLATIONS

- + **DMC 125 U duoBLOCK** with enhanced precision: 5 µm positioning accuracy in all linear axes
- + **Up to 97 %** utilisation in 24/7 operation thanks to automated 5-axis machining
- + **Shelf magazine** with two loading stations for 16 pallets of up to 2,500 kg
- + **Compact wheel magazine** with 243 pockets
- + **DMC 80 FD duoBLOCK**: 50 % shorter throughput times for special chuck jaws due to mill-turn technology
- + **High level of stability** for high-precision turning involving interrupted cuts
- + **Precision and surface quality** eliminate grinding

### DMC 125 U duoBLOCK – automated production of 400 workpiece variants

One goal was to produce all 400 chuck jaw variants in batch sizes of 20 to 80 on just one machining center using large tombstones. A pallet storage system was to be connected in order to maximise the operating time of the machine. The DMC 125 U duoBLOCK 5-axis machining center with pallet changer from DMG MORI proved to be the ideal machine in this case.

Pallet weights  
up to 2,500 kg

### 100 % setup in parallel with production thanks to the unique wheel magazine

The large cubic working volume of the DMC 125 U duoBLOCK can handle workpiece dimensions of  $\varnothing 1,250 \times 1,600$  mm, making it ideal for use of high tombstones. Due to the heavy fixtures, a special version of the machine

pallet with a higher maximum load capacity was designed that increased the standard 2,000 kg to 2,500 kg. A 243-station wheel magazine is used because of the considerable diversity of workpieces and the use of sister tools.

On the one hand the magazine is extremely space saving. On the other it enables setup in parallel with production and non-productive times. "Virtually all machines on the market for the expansion stage we needed had large-chain magazines. In other words, the compact and extremely fast wheel magazine from DMG MORI is unique, so to speak," says Ketterer.

### Setting up 36 clamping positions in less than 15 min.

The pallet system with two loading stations has space for a total of 16 machine pallets. Production takes place using large horizontal tombstones, each equipped with 36 positions for twin powered workholding devices from SCHUNK.

Quick-change inserts are designed for these clamps that need no screws and can be inserted and removed with the aid of ball lock

pins. The result: a tombstone with up to 36 clamping positions in which one part can be replaced by another in less than 15 minutes.

### < 5 µm positioning accuracy in X, Y and Z

The machining process is also designed for maximum operating times. Probing of datum positions has been dispensed with, which of course demands maximum precision of the machine and clamps. The DMC 125 U duoBLOCK with enhanced precision is equipped with cooled drives, coolant temperature control and a thermoshield for preventing draughts. The machine is therefore isolated from the ambient conditions. The result is a positioning accuracy of < 5 µm in X/Y/Z.

### 97 % machine utilisation in 24-hour operation

Setting up plus loading and unloading of the pallets takes place in parallel with production. "On good days we achieve a utilisation rate of 97 % with the machine in 24-hour operation – and this despite the diversity of product variants", stresses Johannes Ketterer.

»



*On good days we achieve a utilisation rate of 97% with the machine in 24-hour operation.*

**Johannes Ketterer,**  
Division Manager on the left in the picture  
and production supervisor Jochen Steinke  
with the DMC 125 U duoBLOCK

**DMC 80 FD duoBLOCK –  
over 50% shorter throughput times  
thanks to complete machining**

In addition to the 1,200 standard chuck jaws, there are also numerous special custom-made products of which around 25% require a turning operation. Until now this was carried out on a lathe after the various milling operations. SCHUNK decided on the DMC 80 FD duoBLOCK from DMG MORI as its first mill-turn machine in order to achieve its aim of responding faster and more flexibly to customer requirements.

Special chuck jaws are now machined on the mill-turn 5-axis machining center in batch sizes of three to twelve. The VERO-S zero point clamping system from SCHUNK was adapted for use on a mill-turn machine and installed on the FD table. Johannes Ketterer is thrilled with the rigidity of the duoBLOCK-design: "The strength of the machine even allows turning

involving interrupted cuts. Hard turning and milling is also increasing and this saves whole process steps and therefore also idle times." A digital process chain was implemented in order to optimise setup times as well. Production programs are created during job preparation, simulated and the clamping configuration defined. "This enables us to cut overall throughput time by half", estimates Ketterer.

**Production to grinding quality  
thanks to the duoBLOCK design  
and SCHUNK clamps**

SCHUNK is more than satisfied with the results. It was possible to reduce the number of clampings in both cases, which is reflected not only in shorter throughput times but also in a higher level of accuracy. Whole process steps can even be dispensed with in part thanks to the perfect synergy of DMG MORI machine and SCHUNK workholding device.

«



**Dr.-Ing. Edmond Bassett**  
Head of Technology Development,  
GILDEMEISTER Drehmaschinen GmbH  
edmond.bassett@dmgmori.com

Exclusive DMG MORI technology cycles

**60% FASTER BY  
CONVERSATIONAL  
PROGRAMMING**

DMG MORI exclusive technology cycles are genuine assistive systems for shop floor programming that help boost productivity, improve safety and enhance the capability of machines.

- + **Clear programming structure**
- + Up to **60% faster** programming
- + **Error reduction** thanks to menu-guided programming
- + **New technologies** (gearSKIVING, Grinding)
- + **Technology know-how** saved in the program



More information about  
the technology cycles at:  
[techcycles.dmgmori.com](http://techcycles.dmgmori.com)



1

**SCHUNK FACTS**

- + Founded as a mechanical workshop in 1945
- + Almost 3,000 employees in nine plants and 33 subsidiaries and distribution partners in over 50 countries
- + Unique in the world: 11,000 standard components for gripping systems and clamping technology



SCHUNK GmbH & Co. KG  
 Bahnhofstr. 106 - 134  
 74348 Lauffen/Neckar, Germany  
[www.schunk.com](http://www.schunk.com)



2

1. DMG MORI technology cycles aid operators with setting up and adjusting the MPC parameters (Machine Protection Control) for maximum security during the automated process.
2. Highly flexible and automated production of over 400 workpieces on the DMC 125 U duoBLOCK with 16-pallet magazine.

**MPC 2.0**

MACHINE PROTECTION CONTROL



- + In-process **vibration monitoring**
- + **Emergency shutdown** in case of a crash
- + **Manual retraction** even in tilted working plane
- + **NEW:** Torque monitoring
- + **NEW:** Recommended with Protection Package for CTX TC machines



**3D quickSET**

TURNING/MILLING



**TURNING**

- + **Toolkit** for review and correction of the kinematic accuracy of 4- and 5-axis machine configurations
- + **All head variants and table axes**



**MILLING**

- + **Measurement and correction of position** of rotary and swivel axes (C4, C3, B)
- + **Sag compensation** possible
- + Can be used in combination with **standard probe** from the customer (Renishaw, Blum)



Time is money: SKF Marine guarantees the shortest possible delivery times of spare parts for marine drives by minimising unproductive times.

# SPARE PARTS WORLDWIDE IN 24 HOURS THROUGH **MILL-TURN TECHNOLOGY**

- + 3 × DMU 125 FD duoBLOCK and 2 × DMC 80 FD duoBLOCK as the mainstay of shaft production
- + **Complete machining** reduces setup times, increases throughput and quality
- + **Production of components with diameters up to 1,600 mm** automated thanks to an integrated pallet changer



*In the event of a breakdown we produce and deliver replacements for defective parts within 24 hours worldwide.*

**Norbert Mäder**  
Production Manager for shafts  
at SKF Marine, Hamburg

**Shorter throughput times and greater precision: SKF Marine has achieved future-proof production with five mill-turn machines from the DMG MORI duoBLOCK series.**

For over 70 years, shipping companies and shipyards have benefited from the expertise that SKF Marine GmbH from Hamburg puts into the production of its shaft components and stabilising systems. Its incorporation into the SKF Group in 2013 also saw a modernisation of production for the former Blohm + Voss Industries GmbH and its around 350 long-term employees. It was needed as the demands on flexibility, delivery times and quality of parts is rising in shipbuilding. With the installation of two DMC 80 FD duoBLOCKs and three DMU 125 FD duoBLOCKs in the last three years, SKF Marine has made a great leap in innovation that enables it to successfully meet the challenges in this highly competitive sector.

The long construction time of a ship and the seemingly leisurely cruising of the giants of the ocean easily obscure the fact of just how fast-paced shipbuilding is in reality. "We produce and deliver replacements for defective parts within 24 hours worldwide in the case of a breakdown", is how Norbet Mäder, Pro-

duction Manager for shafts at SKF Marine, describes the worst-case scenario. Every hour in port gives rise to enormous costs. "But even under normal circumstances, delivery time to a shipyard is today only two weeks, compared to between four and six weeks in former times." Another feature of shipbuilding is the requirement for high quality. This involves both reliability in operation as well as meeting the increasingly stringent environmental regulations. Sealing elements in particular – SKF Marine has around 60,000 of these on the market – are called for, because they prevent sea water from penetrating the shaft bearings and oil from leaking. "That is why we are continuously developing our products", says Norbert Mäder.

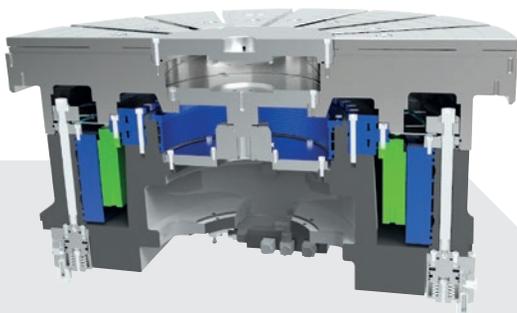
#### **Complete machining in a single setup**

Customer specifications and further technical developments have an impact on production. The focus here is on innovative manufacturing solutions, as the latest investments show. "We used to turn, mill and drill our seals in several process steps on different machines", recalls Norbert Mäder. "That took a lot of time and we were very inflexible." The mill-turn machines from DMG MORI have brought a fundamental improvement in the production of demanding individual parts.

»



The application range of the DMU 125 FD duoBLOCK varies from heavy-duty machining through to µm-accuracy precision machining of seals for powertrains up to 1,600 mm in diameter in a wide range of materials from grey cast iron to chromium steel and bronze.



FD-TABLE

## UNBEATABLE KNOW-HOW, OVER 20 YEARS OF EXPERIENCE

### HIGHLIGHTS

- + **Complete machining** thanks to 5-axis milling and turning in a single setup
- + **Low-wear direct drive** with high torque, e.g. 6,200 Nm in the case of the DMU 125 FD duoBLOCK
- + **Simplest setup** thanks to electronic balancing and hydraulic workpiece clamping

Both the two DMC 80 FD duoBLOCK machines as well as the three DMU 125 FD duoBLOCK machines – the last of which was installed in December 2017 – boost the productivity of SKF Marine significantly, as Norbert Mäder tells us: “Complete machining on one machine is much faster and contributes significantly to higher precision, because manual reclamping is not needed.” The result is better utilisation of machine capacity.

is possible because we have dispensed with the integrated pallet changers”, adds the Production Manager.

A special feature of the five mill-turn machines are the 6-jaw pendulum compensation chucks from SCHUNK. Compared to conventional 3-jaw chucks, they guarantee maximum circularity and therefore also constitute an advantage for the precision of the components. Toler-

## duoBLOCK AT ITS BEST: FD COMPLETE MACHINING TO HUNDREDTHS OF A MM

### Mill-turn complete machining up to 1,600 mm to accuracies within hundredths of a millimetre

The two mill-turn machines from DMG MORI impressed Norbert Mäder and his colleagues not least because they cover an extremely wide range of components. There is sufficient space on the two DMC 80 FD duoBLOCK machines for smaller workpieces, while the three DMU 125 FD duoBLOCK models machine components of diameter up to 1,600 mm. “That

ances at SKF Marine are normally in the range of a few hundredths of a millimetre. “We use specially developed, lightweight variants of the chucks on the three large machines, so we can load up to 1,000 kg”, explains Norbert Mäder. The materials used range from bronze to grey cast iron and chromium steel, which have of course put the efficiency of the machines to the test. “Heavy-duty machining is part of our daily routine.”

**Improved capacity planning thanks to a uniform control philosophy**

The DMG MORI machines have also made SKF Marine more flexible where personnel planning is concerned. Norbert Mäder points here to the uniform control: "Our operators can work on all five machines alike and can step in for each other whenever necessary." Added to this is improved job preparation. "We will change the design and programming of workpieces to SIEMENS NX so that we can supply the machines centrally with NC programs." The Product Manager sees an important step towards further digitization steps here "Optimum planning, management and documentation of the job orders mean we can respond perfectly to the respective order situation." He sees the interplay between machine technology and digitization as the path to future-proof manufacturing in the long term.

**Reliable partner in production**

Norbert Mäder regards the collaboration with DMG MORI as entirely positive – on the one hand due to the proven manufacturing technology and the wide product portfolio: "Models from the DMG MORI range have also been purchased for other areas of production – a DMU 75 monoBLOCK and a CTX beta 800." And on the other hand he appreciates the service from the manufacturer: "Just as our technicians deliver a component to the customer within one day in an emergency, so the experts from DMG MORI are quickly to hand whenever we need them, thus minimising machine downtimes."

**SKF MARINE GMBH FACTS**

- + With over 70 years of experience, SKF Marine produces shaft components for marine drives and stabilising systems
- + SKF Marine has around 60,000 seals on the market
- + If necessary the company replaces defective parts within 24 hours – worldwide
- + Service partnership for maximum utilisation rates



SKF Marine GmbH  
Hermann-Blohm-Straße 5  
20457 Hamburg, Germany  
[www.skf.com](http://www.skf.com)



CELOS with SIEMENS as a uniform control technology enables flexible deployment of operators on the mill-turn machines.



Personal responsibility is important. Programming is carried out offline with NX CAM; man and machine in the workshop ensure perfect quality.

# THE LATEST BENCHMARK IN THE GANTRY SECTOR

## HIGHLIGHTS DMU 340 GANTRY

- + **Stable:** One-piece, thermo-symmetrical machine bed made of EN-GJS-600 for maximum rigidity and accuracy
- + **Dynamic:** Linear drives in the X- and Y-axis with up to 0.5 g acceleration (optional), ram with integrated, direct drive C-axis for excellent dynamics in 5-axis simultaneous machining
- + **Modular:** Extendable up to 6,000 mm in the X-axis and 1,500 mm in the Z-axis

**12 m<sup>3</sup>**  
WORKING  
VOLUME



*Cooperating in the development process has allowed us to adapt the machine to our production requirements. The linear drive with 0.5 g acceleration and the intrinsically rigid machine bed impressed us so much that we ordered two more machines in compliance with our company strategy.*

**Christoph Baumann**  
Managing Director, Baumann GmbH

Technical data		DMU 340 Gantry
Travel X/Y/Z	mm	3,400/2,800/1,250
Rapid feed X/Y/Z	m/min	70/70/60 (90/90/60)*
Acceleration X/Y/Z	m/s <sup>2</sup>	4/4/5
Workpiece weight max.	kg	10,000 (30,000)

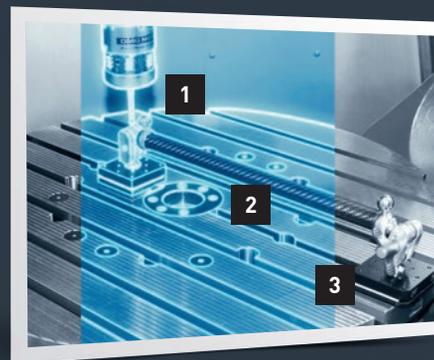
\* with linear drive

NEW

VCS COMPLETE – VOLUMETRIC COMPENSATION SYSTEM

UP TO 30 % HIGHER ACCURACY THROUGHOUT THE ENTIRE SERVICE LIFE OF THE MACHINE

Simple volumetric compensation at the press of a button – including automatic calibration of machine scales and kinematics. The VCS Complete Technology Cycle automatically determines the compensation algorithm for volumetric errors in the work area and can calibrate the machine to micron accuracy. VCS Complete records the data using a tool kit, which comprises a special carbon fibre support with two calibration spheres. This improves the geometric accuracy by up to 30 %. It can also compensate for errors resulting from wear or collision.

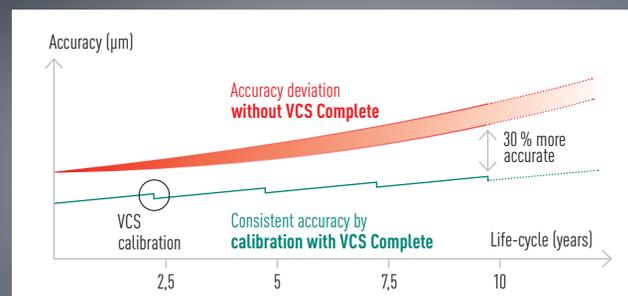


1. Calibration sphere  
2. Carbon fibre reinforced plastic support  
3. Magnet

Exclusive DMG MORI Technology Cycles  
**VCS Complete\***

- + **Up to 30 % higher accuracy** throughout the machine's entire service life
- + **Conversational software** for simple and fast operation
- + **Data recording** for further analyses and documentation of the measured results

\* Available from July 2018 for the DMU/DMC monoBLOCK; other machine series on request



*HSK-A100, 430 Nm and the new Direct Drive B-axis for negative angles up to -10° was already almost enough to convince us. The purchase decision was then made during a live presentation at the EMO show due to the breathtaking dynamics.*

**Ing. Roman Gradwohl**  
Managing Director, Schittl GmbH



*The globally unique wheel magazine for tools up to 650 mm long and tool replenishment during machining, as well as the X-axis extension to 6 m, convinced us to purchase the machine.*

**Thilo Schmid**  
Managing Director, Schmid Messtechnik & Metallbearbeitung GmbH



Find out more about the DMU 340 Gantry here:  
[gantry.dmgmori.com](http://gantry.dmgmori.com)

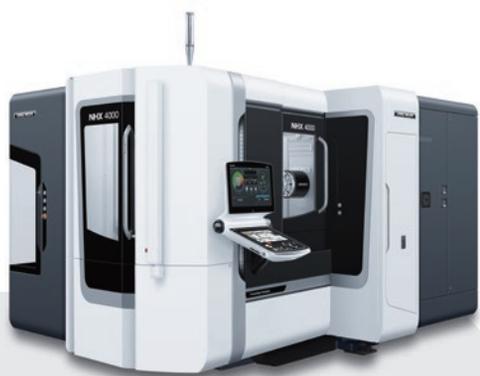


Find out more about the Technology Cycles at:  
[techcycles.dmgmori.com](http://techcycles.dmgmori.com)



The core team of Talon in the production department: Kevin Massey – Machinist, Rich Novak – Manufacturing Supervisor, Corey Bond – Manufacturing Manager, Dave Rietveld – VP of Operations in front of the NVX 5080 vertical machining center.

# PRECISION + SERVICE = GROWTH AND COMPETITIVENESS



NHX 4000

## HIGHLY PRODUCTIVE SERIAL PRODUCTION WITH 1.2G ACCELERATION

### HIGHLIGHTS

- + **High dynamics** with 1.2g for fast chip-to-chip times down to 2.2. sec.
- + **speedMASTER:** maximum chip removal rates with 15,000 rpm, 111 Nm/21 kW (40% DC)
- + **36 month warranty** on the speedMASTER spindle with no operating hours limitation
- + **Direct Drive Table (DDM)** with up to 100 rpm for rapid positioning times of 0.8 sec.
- + Small footprint of just 11.2m<sup>2</sup>
- + **CELOS with MAPPS on FANUC and CELOS with SIEMENS available**

The DMG MORI formula for success, namely **high-tech machine tools + LifeCycle services, is the cornerstone for sustainable profitability and international expansion at Talon Innovations.**

Complex precision components dominate daily machining production at Talon Innovations – whether for external contract manufacturing services or proprietary products. That is why machining processes contribute greatly to the success story of the US company and in turn of course the machining centers and turning machines from DMG MORI.

“Innovation with precision is our motto for greater growth and competitiveness both in our contract manufacturing services as well as our own proprietary products”, explains Dave Rietveld, Vice President of Operations at Talon, right at the start of our visit to the headquarters in Sauk Rapids.

The service portfolio ranges from development and rapid prototyping to machining and fabrication and on through to assembly services and customer support. A second successful business pillar of the company is the specialised ultra-high purity gas and fluid delivery systems of its own TMS line, with which Talon has set new standards worldwide.

### Accuracy + Surface Quality = Precision

The claim of maximum precision at Talon applies both in respect of accuracy as well as surface qualities. Reconciling the two factors economically demands not only careful and competent employees, but high quality machines as well. This applies in particular to the machining of exotic materials, demanding alloys and technical plastics.

### Top Performance in 24/7 Operation

Operability, stability and reliability of the machines and rapid service were all at the top of the customer’s requirements when it came to selecting the machine tool supplier. The fact that DMG MORI has since installed 21 high-tech machine tools at Talon speaks for itself. There are two horizontal NHX 4000 machining centers in the production hall, for example. Two NTX 2000 turn & mill machines handle 6-sided complete machining of rotationally symmetrical components. Added to this are any number of vertical machining centers including, for example, five CMX 1100 V centers and two NVX 5060/5080 models. Dave Rietveld draws a very positive conclusion: “The machines enable us to produce even the most complex geometries with extreme tolerances and outstanding surface qualities.”



1. 6-sided complete machining on two NTX 2000 turn & mill machines from DMG MORI.
2. 24/7 production on one of the two NHX 4000 machines with the speedMASTER spindle from DMG MORI.

### Reliability + Service = Productivity

24 / 7 operation on the shop floor also defines the requirement. Talon produces 24 hours a day, 7 days a week at all its locations. "So service and fast response spare parts provision are just as important as reliable machine tools if the worst comes to the worst," stresses David Rietveld in a final comment.

«

### TALON INNOVATIONS FACTS

- + Founded 1994
- + 375 employees
- + Sites in Osakis, Minnesota, Tampa, Florida and Seoul/Korea
- + End-to-end provider of precision parts
- + Gas and fluid delivery systems as a second business pillar



Talon Innovations  
1003 Industrial Dr. S,  
Sauk Rapids, MN 56379, USA  
[www.taloninnovations.com](http://www.taloninnovations.com)



**WORLD  
PREMIERE  
2018**

NTX 3000

**16.3 m<sup>2</sup>**  
FOOTPRINT

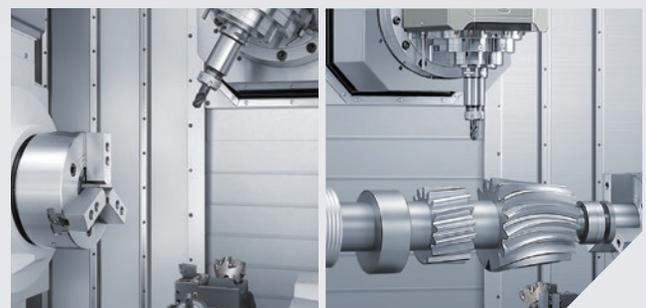


NTX 3000

## BEST IN CLASS TURN & MILL – turnMASTER WITH 1,194 Nm AND compactMASTER WITH 120 Nm

### HIGHLIGHTS

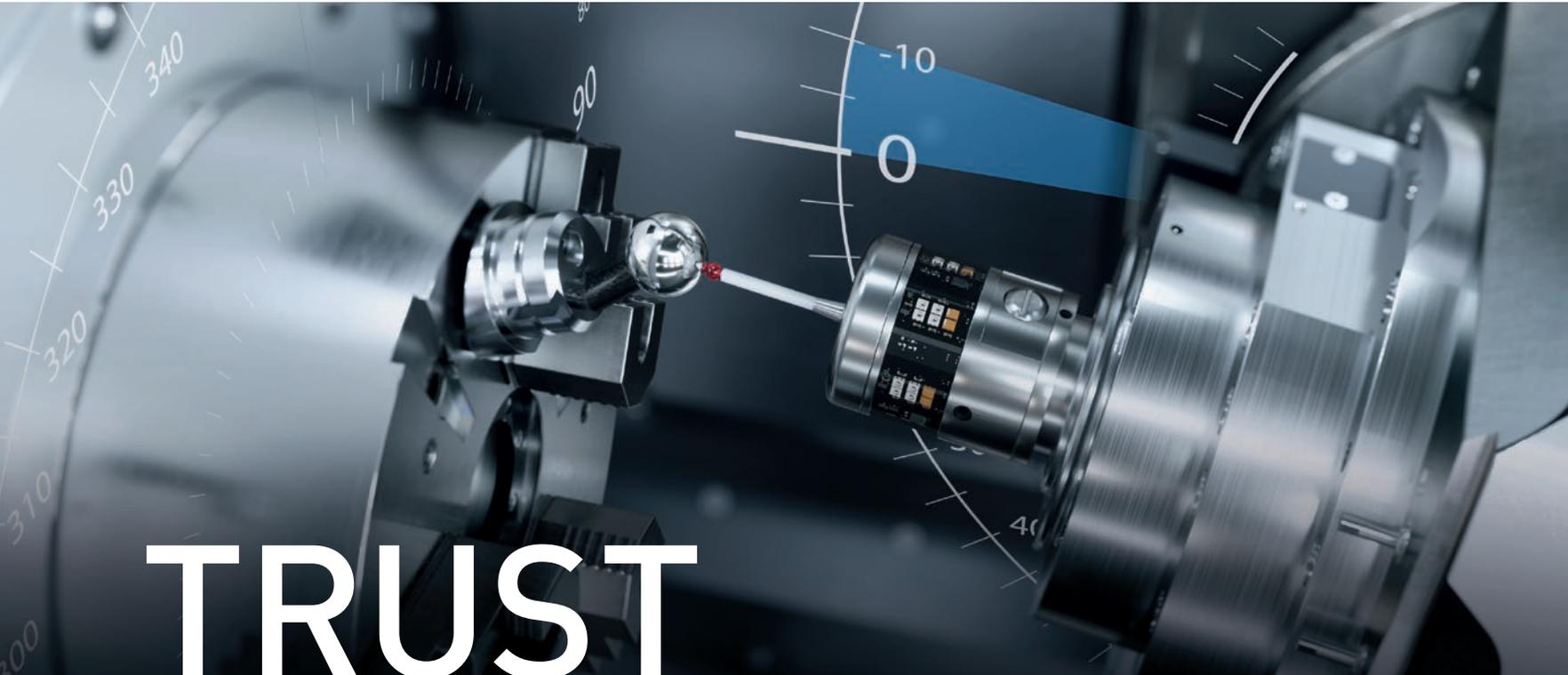
- + **turnMASTER** spindle (12" chuck) with 3,000 rpm and max. 1,194 Nm (optional 8" / 10")
- + **compactMASTER** turn & mill spindle with 120 Nm torque and 350 mm length
- + **Multitasking:** direct drive B-axis for 5-axis simultaneous machining of complex workpieces
- + **Maximum flexibility** thanks to its X-axis stroke of up to -125 mm under spindle centerline
- + **CELOS with MAPPS on FANUC and CELOS with SIEMENS available**



6-sided complete machining of complex workpieces up to  $\varnothing 670$  mm and 1,540 mm in length with the compactMASTER turn & mill spindle and second tool carrier (lower turret) with 80 mm Y-axis.



Find out more about the NTX 3000 at  
[ntx.dmgmori.com](http://ntx.dmgmori.com)



# TRUST IS GOOD – DMQP IS BETTER

## 4 ACCESSORIES FOR PERFECTLY MATCHED MANUFACTURING SOLUTIONS

1	MACHINING	2	HANDLING
	<ul style="list-style-type: none"> <li>+ Coolant chiller</li> <li>+ Oil mist separators</li> <li>+ Steady rest</li> <li>+ Tool /holders</li> <li>+ Tools</li> <li>+ Rotary tables</li> <li>+ Clamping fixtures/chucks</li> <li>+ Air filters</li> <li>+ Software (CAD/CAM)</li> </ul>		<ul style="list-style-type: none"> <li>+ Bar feeders</li> <li>+ Automation (robots, workpiece and pallet handling)</li> <li>+ Chip conveyors</li> <li>+ Grippers</li> </ul>
3	MEASURING	4	MONITORING
	<ul style="list-style-type: none"> <li>+ Measuring probes</li> <li>+ Tool/workpiece measurement systems</li> <li>+ Tool presetters</li> </ul>		<ul style="list-style-type: none"> <li>+ Transformers</li> <li>+ Signal lamps</li> <li>+ Cameras</li> </ul>

An integral manufacturing solution from a single source at fair prices. This is exactly the benefit DMG MORI offers with its DMG MORI Qualified Products (DMQP) initiative. The global concept and close cooperation with certified DMQP partners promises perfect synergy between machine and accessory for maximum technological competence.

### All-round carefree package without compromise

DMG MORI development and application engineers work together with DMQP partners all around the world on the continuous optimisation of existing manufacturing solutions and the development of new and innovative ones. "Our aim is to offer our customers an all-round carefree package. To ensure this is the case, all accessories undergo extensive testing and selection processes," explains Dr. Thomas Froitzheim, Head of the DMQP program at DMG MORI. "For us, DMQP is a seal of quality that we only grant if productivity, approval, availability and connectivity are all perfect – no compromises are made", he goes on to tell us.



**Dr. Thomas Froitzheim**  
Your contact person for DMQP in Europe  
dmqp@dmgmori.com

### Perfectly matched accessories from a single source

The DMQP program also ensures structured recording and processing of customer feedback. "Really innovative solutions are developed in partnership and are seldom the result of explicit customer requirements", stresses Dr. Froitzheim. The outcome is perfectly matched accessories that are offered at fair prices from a single source in the four large DMQP categories of machining, handling, measurement and monitoring. This makes

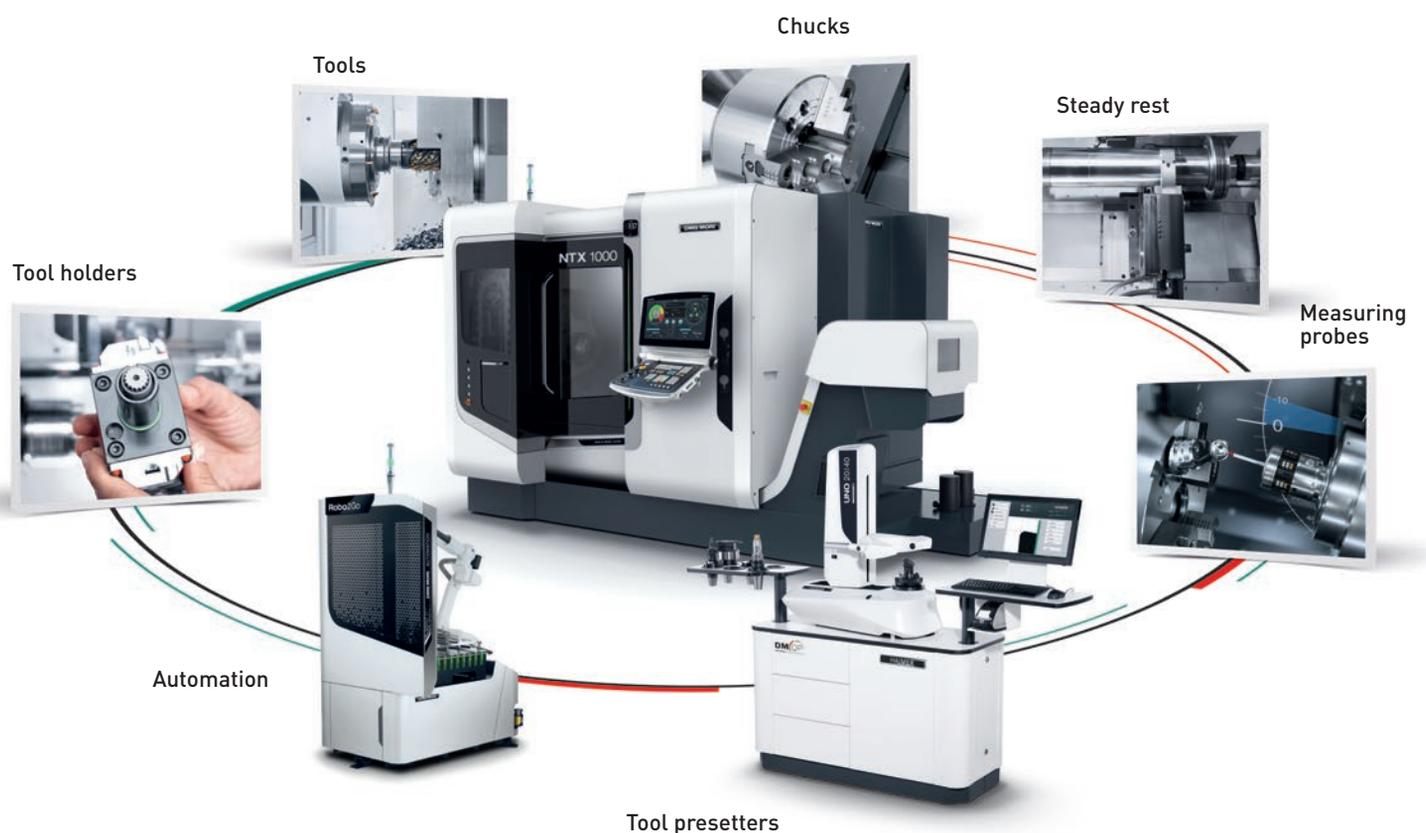
procurement less complex for customers and guarantees a highly innovative product portfolio with certified DMQP partners at an attractive price. The warranty conditions correspond to the respective machine tool. And finally, the company takes care of the entire process, from consultation for the purchase and installation through to service and the ordering of spare parts. This means speedy support in an emergency.

According to Dr. Froitzheim, all suppliers will also profit in the end through DMQP. He said, specifically addressing these partners: "Suppliers are also DMQP winners because, as certified partners, their products will be presented during the initial sales meetings and will therefore be seen by the customer!" And, of course, these discussions are carried out around the world by the largest sales team that the global machine tool building sector has to offer.

## DMQP CUSTOMER BENEFITS

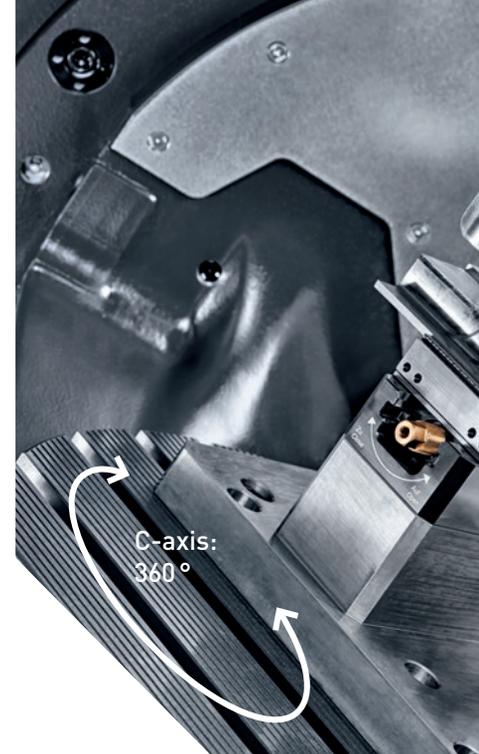
- + **Everything from a single source** – machine, accessories and service
- + **Perfect match** – connectivity of all DMQP products tested and guaranteed
- + **Certified quality** and standardised interfaces
- + All DMQP products at **market price**
- + **Recommended product packages** for special customer applications
- + **Identical warranty conditions** to those of new DMG MORI machines
- + DMQP partners must meet the **highest innovation, competence and quality requirements**

## DMG MORI QUALIFIED PRODUCTS – EXAMPLES



# BEST-SELLER

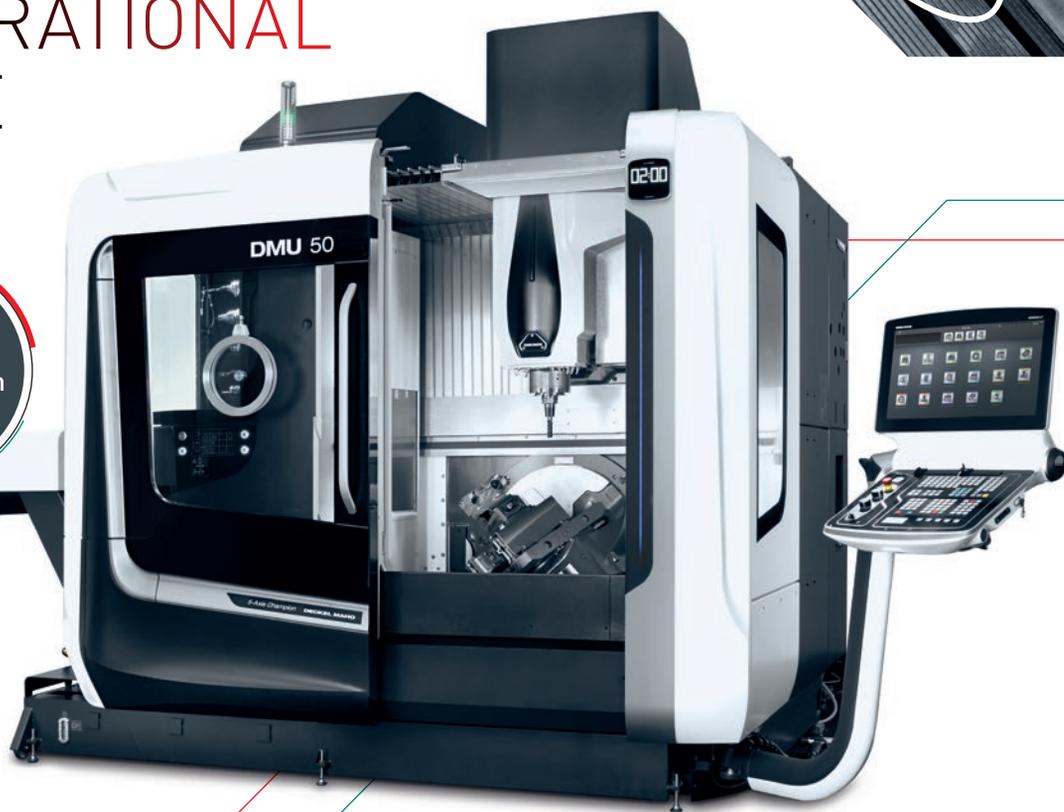
MORE THAN 15,000  
DMU 50 OPERATIONAL  
WORLDWIDE



#### Technical data

Travel X/Y/Z: 650/520/475 mm,  
Max. speed: 20,000 rpm, Rapid feed X/Y/Z:  
42 m/min, Clamping area:  $\varnothing$  630 x 500 mm,  
Max. load: 300 kg

5-AXIS  
MACHINING WITH  
speedMASTER SPINDLE  
AS STANDARD



The 3<sup>rd</sup> generation of the DMU 50 is a mechatronic masterpiece, 20 years on from the original version, and an absolute bestseller in the DMG MORI product range. Following on from the lightning start last year, 2018 sees over 800 machines in the production plan.

78 % more working area, 40 % faster rapids, 28 % more swivel angle, faster rotary-swivel speeds and power speedMASTER spindles with 36 months warranty and no limit on operating hours. This is combined with tool magazines for up to 120 tools and comprehensive cooling for outstanding precision down to 5  $\mu$ m.

#### HIGHLIGHTS

- + 5-axis machining at up to 20,000 rpm
- + Swivelling rotary table for 5-axis simultaneous machining
- + Tool magazine with 30 pockets as standard and optionally up to 120 magazine pockets
- + Integrated cooling concept for unrivalled long-term precision
- + Directly-driven ball screw drive for the best possible accuracy
- + Linear scales in all axes
- + Optimal automation from the side



B-axis:  
-35°/+110°



Swivelling rotary table for 5-axis simultaneous machining of workpieces up to 300 kg.

Overall, the 3<sup>rd</sup> generation DMU 50 offers decisive added value. This also applies to the diversity offered within the *ERGOLine* portfolio with high-tech CNCs from SIEMENS, HEIDENHAIN and FANUC.

Due to its flexibility and versatility, the DMU 50 3<sup>rd</sup> Generation can be found in almost all sectors – from single part production right up to mass production. Additional static and dynamic rigidity is provided by the stable (monolithic) machine bed and low center of

## BESTSELLER WITH TOP QUALITY FOR 5 μm PRECISION

gravity. In combination with directly driven ball screw drives, linear scales and comprehensive cooling, it provides unique precision in this machine class. The DMU 50 3<sup>rd</sup> Generation is therefore recommended as an ideal, cost-effective means of getting ahead in the fascinating world of 5-sided or up to 5-axis simultaneous machining.

«

DMU 50



W × D × H: 2,197 × 2,264 × 2,780 mm  
< 5 m² footprint

### DMU 50 2<sup>nd</sup> GENERATION

## 5-AXIS TOP SELLER FOR TRAINING AND WORKSHOPS

### HIGHLIGHTS

- + NC swivelling rotary table for **5-axis simultaneous machining** with high rigidity
- + Swivel range NC rotary table: -5° to +110°, **heavy workpieces up to 300 kg**
- + Direct-drive spindle with 14,000 rpm as standard, optionally 18,000 rpm
- + Tool magazine for **up to 60 tools** can be retooled during machining
- + **Latest 3D control technology: CELOS with SIEMENS and 21.5" ERGOLine**
- + Optional HEIDENHAIN iTNC 530 with 19" ERGOLine

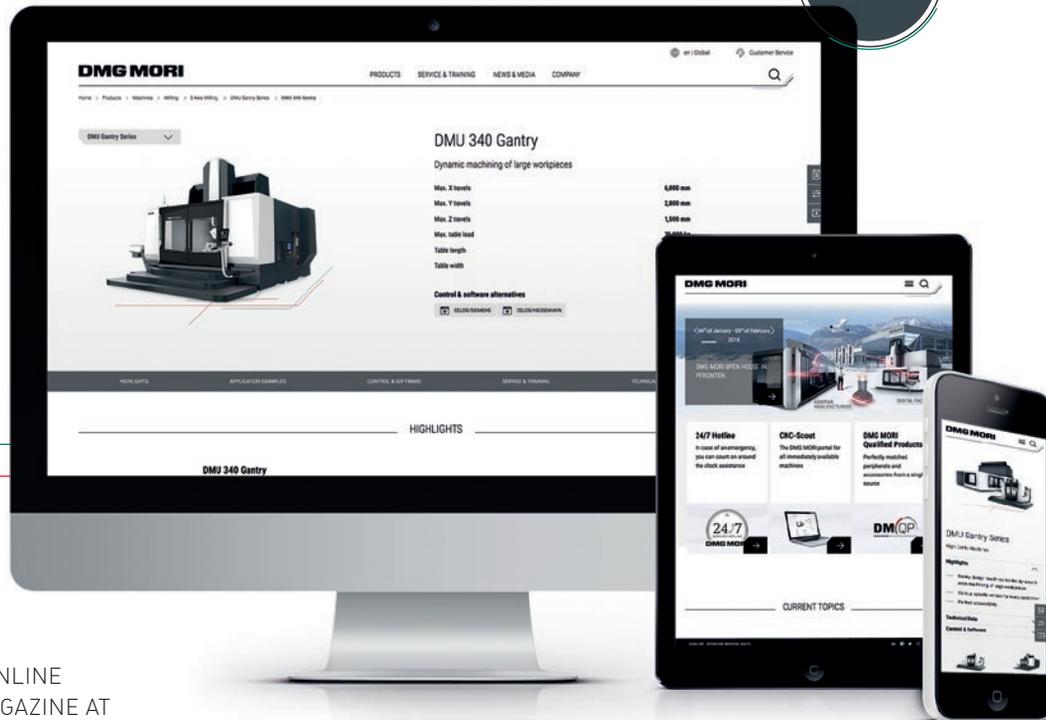


The 2<sup>nd</sup> Generation DMU 50 is more than just a predecessor. Training organisations and workshops in particular value its compactness and the high-tech control technology as a route to digital production.



More information about the DMU 50 can be found here:  
[dmu.dmgmori.com](http://dmu.dmgmori.com)

# NEW: DMGMORI.COM



YOU CAN FIND AN ONLINE  
VERSION OF THE MAGAZINE AT  
[MAGAZIN.DMGMORI.COM](http://MAGAZIN.DMGMORI.COM)



## SAVE THE DATE

- + Innovation Days Chicago/USA: 07. – 10.05.2018
- + Open House Bergamo/IT: 10. – 12.05.2018
- + Innovation Days Iga/JP: 22. – 26.05.2018
- + Open House Bielefeld/DE: 12. – 15.06.2018
- + Grand Opening FAMOT/PL: 08. – 12.10.2018
- + 2<sup>nd</sup> Ulyanovsk Technology Symposium/RU: 16. – 19.10.2018
- + Open House Seebach/DE: 06. – 09.11.2018



Experience  
DMG MORI live  
[events.dmgmori.com](http://events.dmgmori.com)

IMPRINT: DMG MORI TECHNOLOGY EXCELLENCE — Magazine for customers and interested parties.  
Publisher and responsible for the content: DMG MORI Global Marketing GmbH, Walter-Gropius-Straße 7,  
D-80807 Munich, Tel.: +49 (0) 89 24 88 359 00, [info@dmgmori.com](mailto:info@dmgmori.com)  
Edition: 840,000 copies. Technical changes, availability and intermediate sale reserved. Our respectively  
applicable general terms and conditions are valid.

# DMG MORI