

Rebuilding a Legacy

BOURN & KOCH PROVIDES RETROFIT MACHINE FOR GEAR SHAPING
JOE GORAL, BOURN & KOCH

When Bourn & Koch purchased the Fellows Gear Shaper Company in 2002, there was considerable excitement about the possibilities for the little-known machine tool company from Rockford, Illinois. Though the purchase of Fellows wasn't their first foray in to acquiring a gear company, it had been 17 years since Bourn & Koch had bought Barber-Colman's machine tool division, acquiring their gear hobbing machine designs and repair parts and service business. The acquisition of Fellows offered numerous opportunities to expand Bourn & Koch's footprint into the world of gear manufacturing.

Since the acquisition of Fellows in 2002, Bourn & Koch has developed new models of Fellows gear shapers and has been awarded patents on designs that have been incorporated into these machines, most notably the use of flexure plates to increase stiffness in the cutter spindle housing, removing the need for hydrostatic pads. Though their new machine designs offer a long list of cutting-edge technologies, Bourn & Koch has always had a strength in remanufacturing older Fellows gear shapers.

A typical remanufacture process will not only bring the machine up to today's standards for CNC controls and machine systems but will also restore the machine's alignments or original factory specifications. In essence, it is a new machine using very well-seasoned castings. As one might imagine, the process is time consuming and costly, but typically results in a machine that is two-thirds the price of new. On specialty machine tools, such as gear manufacturing equipment, this can mean considerable costs savings to the customer.

Understanding the increasing need for many companies from job shops to OEMs to update their gear manufacturing machinery or to outright add this to their capabilities, Bourn & Koch took the time to rethink their offering to the market for gear shaping machines, focusing on the Fellows 10-4 in particular.

Lloyd Koch, co-founder of Bourn & Koch and machine tool guru,

Fellows 10-4 Retrofit by Bourn & Koch.



headed up the effort to provide a more cost efficient and adjustable version of the Fellows 10-4 to the market. Koch, a former engineer at Sundstrand Machine Tools, knows the rebuilding process like the back of his hand; it is how Bourn & Koch got started in 1975, rebuild and retrofitting Sundstrand's machines. Larry Bourn & Loyd Koch started rebuilding machines in 1971, eventually forming Bourn & Koch in 1975.

Starting with an original Fellows 10-4 serial number 34807, Loyd and the team of gear technicians at Bourn & Koch disassembled the machine, painstakingly inspecting the parts as they were removed to determine if they met OEM tolerances. The parts that did not pass inspection were discarded and replaced with new, manufactured per Fellows OEM prints.

Once disassembled, the bare castings were now a blank canvas for Loyd and

the engineering team at Bourn & Koch to start anew, attempting to balance the delicate task of reducing cost while maintaining quality. Any gear shaper whether new, remanufactured, that leaves Bourn & Koch must produce AGMA class 10 gears on all measured features. The goal for the rebuilt machine was to be able to provide a minimum of AGMA class 9 gears. The result was a class 10 gear produced at run-off.

Two of Bourn & Koch's current engineering staff, Wayne Densmore and Steve Ray, started their careers at Fellows, accepting positions with Bourn & Koch when the company was acquired. Densmore is a mechanical engineer by training, responsible for numerous designs both at Fellows and Bourn & Koch that have stood the test of time. Around the office, Densmore has a reputation for designing machine tools that are of an equivalent duty to those made in the heyday of American



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Machine Tools. Ray, a software and controls engineer, has been responsible for development of Bourn & Koch's human machine interface (HMI) software over the past 16 years. He's been an integral part of many new software features on both gear hobbing and gear shaping machines during that time. Both Ray and Densmore were integral to the effort to bring this "new" product to market.

While Fellows produced a reliable, stout, gear shaper, the controls on the machines, much like any electronic component, become obsolete. Bourn & Koch

primarily uses Fanuc on their machine tools, from gear hobbers and shapers, to cylindrical and surface grinders. The standard for Bourn & Koch gear machines has been the Fanuc 0i-MF with a PC front end to host their gear manufacturing HMI. Understanding that the needs of the gear manufacturing market vary, Bourn & Koch designed a new CNC package with Fanuc Macro Executor on the 35i CNC control. Bourn & Koch already had a leg up on using this control for their new Blanchard grinders, so the transition from 0i to 35i was a relatively



AGMA 10 gear cut on the 10-4 Retrofit.

painless process. This also provides a familiar programming option to those familiar with Fellows original programming via Macro Executor.

During the design stage of the project, numerous considerations were made as to how the machine could be more accurate and adjustable, while reducing cost. Starting with the machine's x-axis, the team at Bourn & Koch looked at how to simplify the design while increasing infeed accuracy during the gear shaping operation. The decision was made to convert the machine's x-axis for infeed and positioning to direct drive with a ball screw and servo motor. Employing a Fanuc Beta-I 12 servo in lieu of their standard Alpha-I 8 servo, the new design for the x-axis on the machine now has more torque and higher accuracy due to the removal of the gearing in the original design. This also resulted in reduced costs as fewer moving parts are now required.

The same philosophy was applied to the machine's c-axis for the work spindle. Typically, a new or remanufactured 10-4 gear shaper would have a drivetrain through a spline shaft to rotate the table. The machine now has a direct drive work spindle, which improves accuracy and reduces backlash in the drive train. The original design incorporated a gear train and spline shaft to drive the table. With the direct drive design, those components are eliminated, reducing cost both at the time of machine build and during machine ownership. This also offers a mechanical advantage over typical belt drive systems.

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At the heart of a gear shaper is its spindle. The stroke and rotation of the spindle are the driving force behind the generation of the gear teeth. Particular attention was paid to how to improve this area of the machine while reducing cost in the rebuild process. To further reduce cost, a Fanuc servo motor was used in place of a Fanuc spindle motor. This also reduces the number of components required to retrofit the machine to CNC including the disc brake but provides the added benefit of programmable quick return stroking.

Floor space is a large concern in many shops these days. With square footage being at a premium, compact machine designs can have a distinct advantage in process to determine what machine

will ultimately be selected for purchase. To reduce the footprint, Bourn & Koch considered many aspects of the machine, most notably the guarding package and the hydraulic unit.

A simplified guarding package was designed for this new offering to reduce both cost and required floor space. While the new guarding package is less costly, it does not sacrifice the required safety features and ergonomics requirements that many companies have. The guarding package allows operators easy access to the machine's workzone for setups.

With the removal of the hydrostatic pads and use of a mechanical guide in lieu of hydrostatic, the hydraulic requirements of the machine were greatly reduced. This allowed for a smaller

hydraulic unit to be incorporated to the build, further reducing floor space. The new hydraulic unit also runs intermittently, saving on energy costs.

The new guarding package and smaller hydraulic unit reduced the overall required machine footprint by 16.5 square feet.

Maintainability is a focus of many companies in the machine selection process these days. Extended service contracts and extended warranties are all a sign that companies are looking to ensure the machine can be maintained by experts from the factory. That being said, a gear shaper is not in the same class as a milling or turning machine. They require fine adjustments and specialized knowledge to continually produce high class gears. With that in mind, Loyd and the team at Bourn & Koch worked toward developing methods to easily adjust the machine.

The cutter nut on the spindle was modified to allow it to be adjusted via set screw. The guide attachment is now adjustable via set screw as well.

Further improvements to the c-axis were made through retrofitting the table bearing cap to allow for preload adjustment without disassembly. Typically, a Fellows 10-4 gear shaper requires that a spacer be ground to fit in order to set the preload of the table bearing. This step is eliminated in the rebuild process and for future maintenance by incorporating the cap design. Table bearing preload is necessary for producing an accurate gear. With this step simplified, the machine's ability to continually and reliably produce accurate gears over its lifetime is greatly improved.

Overall, the "new" Fellows 10-4 retrofit offers companies a cost-effective way to add or upgrade their gear shaping capability without sacrificing quality. With Bourn & Koch's OEM support and technical expertise on Fellows, companies can be well assured that they are getting a quality machine backed by a team that knows their gear shaping machine inside and out.

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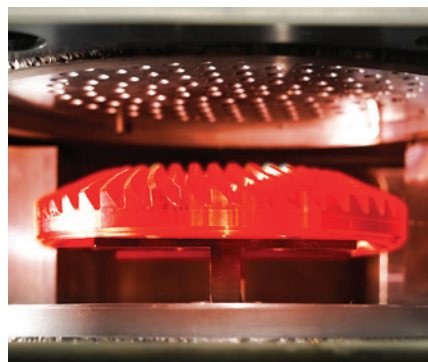
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INSTALLS DEBURRING-AUTOMATION-CELLS TO INCREASE ZSO PRODUCTION

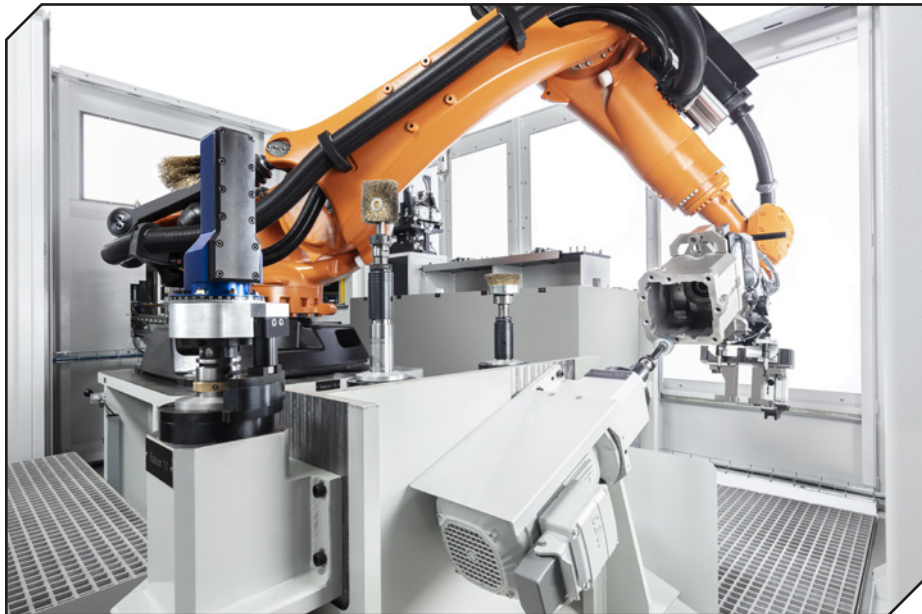
Kadia's portfolio includes a wide variety of deburring machines, most of which are designed for fully automatic operation with the aid of a robot. At

Zerspanungs- und Systemtechnik GmbH (ZSO) in Oberstufen, the Nürtingen experts implemented three deburr-automation-cells. The tasks of these systems

include not only deburring the workpieces, but the robots also take over the complete handling for mechanical processing.

For ZSO, it is clear that quality, process reliability, and productivity must be raised to a maximum level, and this is only possible if processes are consistently automated. For this reason, ZSO has invested heavily in handling systems and the networking of its machinery in recent years. Of the 35 processing machines currently in use, a third are already fully automated.

One of the most recent projects was particularly important for ZSO Managing Director Carsten Binder, Ph.D.: The handling and deburring of grey cast iron housings for mobile hydraulic pumps weighing up to 26 kilograms. These are, for example, pumps for the hydraulic systems in construction machinery. The housings go directly from the foundry to ZSO, where they are



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INTRODUCES TBK 2014 UPDATE

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“Our plan was to have a robot carry out all the recurring processes,” said Binder. “Deburring would also be possible on the machine tool, but a robot is the far more cost-effective solution for this.”

In Kadia, ZSO finally found a partner with the corresponding expertise in the fully automatic deburring of heavy workpieces. After a short time, the design engineers in Nürtingen presented a concept that convinced the ZSO managers. It is based on a 6-axis robot with a payload of 120 kg and a reach of 2.5 m. Kadia’s customers receive such solutions completely from a single source. That means the scope of supply includes the process development, robot, cell, gripper, deburring stations, and tools including special solutions. Not to forget, of course, the sequence programming with all safety-relevant designs.

Kadia delivered a first automation cell in April 2019, a second in September and a third in January 2020.

“It is important for our customers that we were able to increase process reliability and thus product quality during deburring,” said Binder. “All edges are now deburred absolutely evenly, and according to customer requirements, there are no variations in the execution. In addition, the robot never forgets an edge or thread. This means that reworking is also a thing of the past.”

For more information:
Kadia Inc.
Phone: (248) 446-1970
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GWJ Technology introduces new features with latest software release of *TBK 2014*. With the newest version of the calculation software the user gets a powerful tool to determine, dimension and optimize gearboxes. Just as in previous versions, existing modules were improved and optimized.

Several new functions and settings are included in the software update. For example, additional options for the profile shift sum as well as for the profile shift coefficients were added, new basic rack profiles for plastic gears according to ANSI/AGMA 1106-A97 were integrated and the load capacity of plastic gears can now be calculated according to VDI 2736 in the cylindrical gear module.

The first plastic materials were added to the general material database. For this, the temperature-dependent material properties such as fatigue strength and E-module were approximated in detail from available diagrams in VDI 2736 and stored accordingly.

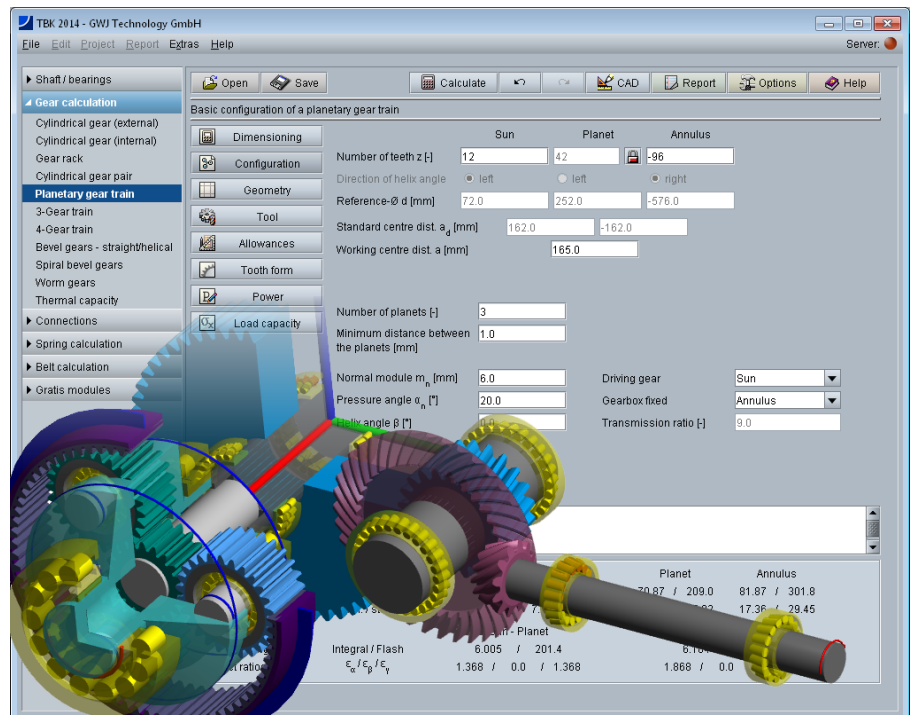
Pairings of plastic/plastic as well as

plastic/metal are supported. In the load capacity calculation of worm pairings, the calculated power losses can be overwritten or specified individually. This means that the load capacity calculation can be better adapted to the results of test bench trials.

Both versions of DIN 743 (version 2000 and 2012) are now available for calculating the fatigue strength and safety against permanent deformation of shafts. The desired version can be selected in the settings menu. The default standard is now the version DIN 743: 2012.

Also worth mentioning is the support of the latest software version *SystemManager* in conjunction with *TBK 2014*. Optimized usability and new functions make working with *TBK 2014* and the *SystemManager* more efficient, especially with regard to more complex systems like multi-stage cylindrical gearboxes or planetary gear sets.

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OFFERS WHEEL MOUNTING CART FOR GEAR GRINDING MACHINES

The Reishauer Wheel Mounting Cart, ErgoMount, enables the machine operator to ergonomically and safely change grinding wheels and clamping tool arbour's up to a weight of 40 kg. The unit has been designed for the RZx60 gear grinding machine series. It allows the direct mounting of a grinding wheel on the main spindle without any additional

tools. Thanks to the well-thought-out fast-changeover system and the relevant load-bearing elements, the changeover between the setups for grinding wheels and clamping arbour's is done in next to no time. The electrical lifting axis is controlled by a joystick and makes for comfortable operation.

The mounting cart complies with all



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relevant machine and working guidelines; offers fast and safe changing of grinding wheels and workpiece clamping arbour's; an integrated grinding wheel setup device, pivotable by 90°; fast-changeover system with ball lock pin; clear layout of operating elements and readout instruments; storage positions for two grinding wheel and 3 clamping arbour's; includes a generously dimensioned and lockable tooling drawer; excellent maneuverability and compact design.

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TCI Precision

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TCI Precision Metals has announced the addition of specialized round stock conversion to squared, high precision Machine-Ready Blanks.

Depending on job specifications or customer preference, round and square, precision Machine-Ready Blanks are now available, starting from round raw stock. "Some customers prefer to start with round stock material even when the finished machine-ready material needs to be square, but most of the time it comes down to alloy selection and availability," said Ben Belzer, president and COO of TCI Precision Metals. "For example, 144 Cold Finished Carbon

precision blanks ready to load directly into their CNC machining centers. Precision blanks eliminate the need for in-house sawing, grinding, flattening, squaring operations and outside processing. Each blank arrives deburred, clean and to customer specifications — guaranteed as close as +/- .0005" dimensionally and as close as .002" flatness, squareness, and parallelism. Customers are able

to use the time they previously spent in setup and prep for more productive use of CNC machining centers, adding to their bottom-line profitability.

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Steel and 465 Stainless Steel are both far more readily available in round stock. There tends to be more waste converting round materials to square machine-ready blanks, but if specifications or material availability dictate, TCI can now efficiently deliver on the request with our 'round to square' milling services," added Belzer.

TCI sawing, milling, and grinding equipment are all designed for high volume production and are configured to convert and prep virtually all materials to precision machine-ready specifications much more efficiently than most shops can do in-house.

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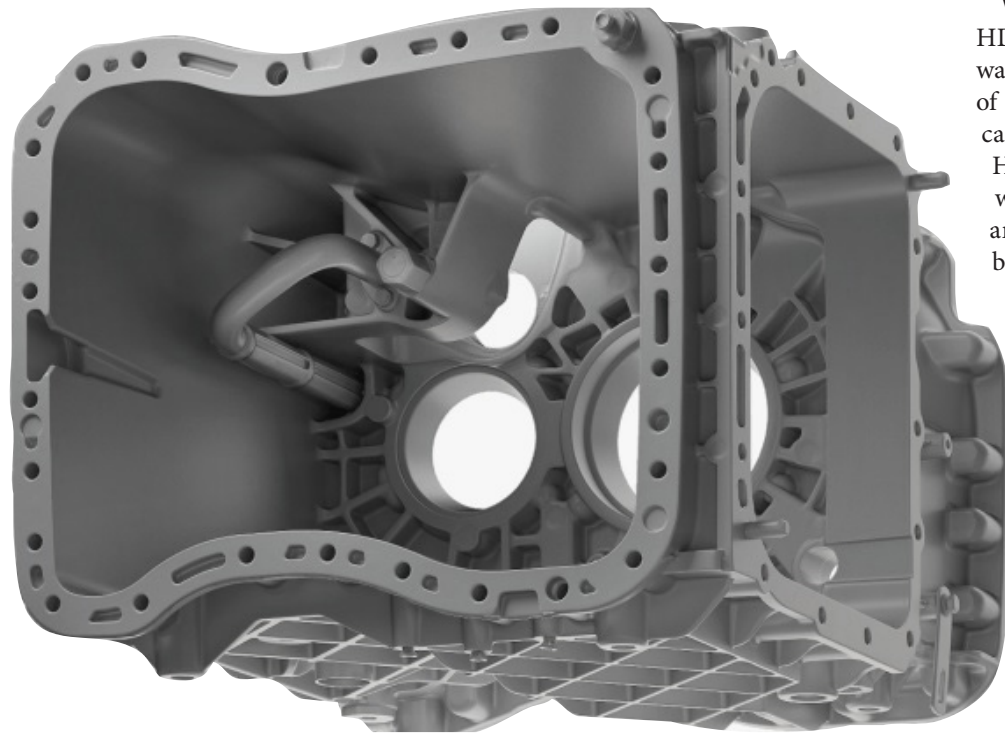


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Artec 3D

DOUBLES RESOLUTION FOR HANDHELD SCANNERS

Artec 3D, a developer and manufacturer of professional 3D hardware and software, has announced the successful development of a proprietary AI Engine that more than doubles the resolution of its Eva and Leo handheld scanners to 0.2 mm in a newly released HD Mode. Artec 3D is the first and only company to utilize deep convolutional neural networks to reconstruct 3D surfaces and improve the quality of 3D models. With HD Mode, users can create excep-



tionally accurate, low-noise scans of smaller, more detailed objects with complex surfaces, as well as large, intricate objects. HD Mode is free and available now for all Eva and Leo users via Artec 3D's latest scanning and data processing software, Artec Studio 15.

"With the help of in-house developed training techniques and CNNs, we've managed to squeeze more information from the same amount of data captured from our existing 3D Eva and Leo scanners and get a much richer and denser representation of the scene being scanned," said Gleb Gusev, CTO of Artec 3D. "Now we're able to receive up to 64 times more measurements from the same scanners, which more than doubles

the resolution of the final model and significantly decreases noise. Another advantage of our new approach is the much more accurate reconstruction of the surfaces this technique provides compared to standard algorithms."

"We are committed to creating life-long Artec 3D users, not only by developing the industry's most cutting-edge new 3D technologies, but also ensuring that the performance of our exist-

ing solutions is continuously being enhanced," said Artyom Yukhin, President and CEO of Artec 3D. "The release of HD mode, powered by a first-of-its-kind neural network, is an extraordinary milestone for the 3D scanning industry that our users can benefit from right away. It's incredibly rare for any company to release such a significant upgrade at no cost, but we want users to rest assured that when they invest in our technology it will continue to pay off for years to come."

Artec 3D has a deep history in computer vision and AI, creating AI algorithms for its own 3D facial recognition devices, as well as for technology

industry leaders. Most notably, Artec 3D's team of AI experts worked with Apple to help develop its Face ID. Now, Artec 3D has leveraged its expertise to apply AI not only to 3D faces, but to 3D objects of any kind. The convolutional neural network powering Artec 3D's AI Engine in Studio 15 software has been trained using millions of data points and hundreds of thousands of 3D models to ensure optimum performance in HD Mode.

When an Eva or Leo operator turns on HD Reconstruction, they can look forward to scans with unparalleled degrees of resolution, coverage, and detail. They can also select the desired density for HD scans, from a standard 1X all the way up to an astonishing 36X for Eva and 64X for Leo. To experience the benefits of HD Mode, users must utilize computers with NVIDIA GPUs and 2 GB (Eva) / 4 GB (Leo) of video RAM for proper scanning and data processing. NVIDIA is the Artec 3D recommended graphics card brand for Artec Studio users.

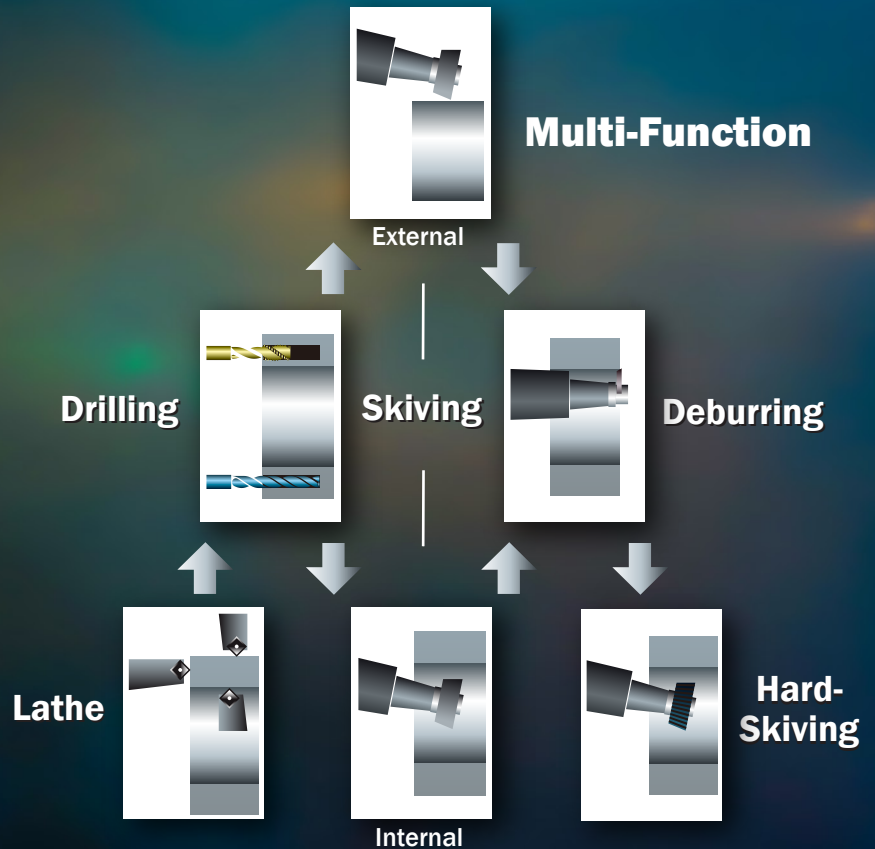
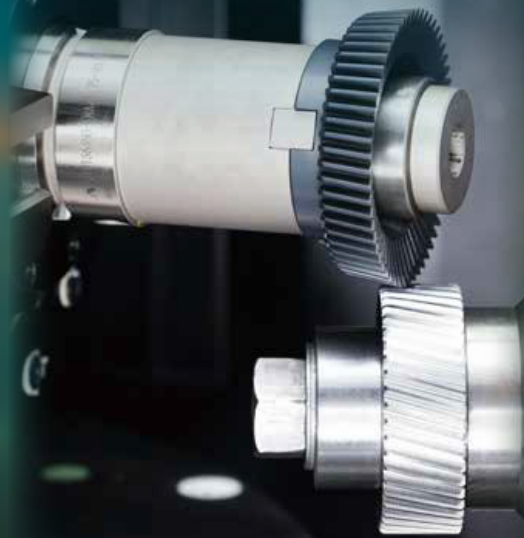
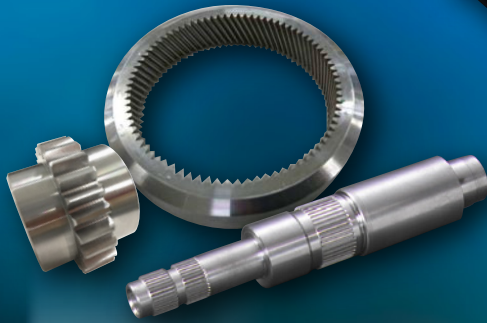
HD Mode allows users to scan more detailed objects in over twice the resolution, with Eva and Leo scanners. This mode easily captures sharp and thin edges in higher definition. Even complex structures with various hard-to-scan surfaces, such as those featuring holes and gaps, varying depths and angles, and recessed areas are now systematically reconstructed in every single frame to deliver the best possible scan. With HD Mode, tricky surfaces, such as those that are deep black, shiny, or covered in hair or fur, are also easier to digitize with incredible detail. HD mode has an elite level of noise reduction in both raw data and final model, making scanned objects ready for reverse engineering, as well as many other applications, without needing any editing.

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EMAG

WINS RED DOT AWARD FOR AI SOLUTION

The factories of the future are connected — in every respect: Machines communicate with each other regarding errors or required maintenance, while providing essential information to production planners that can control the machines from one central point. With this system, planners can create intelligent production systems that can manage tasks even more efficiently. With the creation of a new modular ecosystem, that has just won the Red Dot Award (Best of the Best), the EMAG Group has made this vision a reality, simplifying both operation and networking of the machines. Initial applications used by customers have been impressive in demonstrating how the entire production process is made much more transparent and efficient with this system.

Many experts forecast a “chaotic” future for production including constantly changing parts and fluctuating batch sizes, requiring the use of extremely flexible production solutions. In the end, this can also mean that, where five machines used to be necessary for handling different components, there could be only one in the future — capable of doing everything, perfectly connected to the production

network. This, however, means that the focus on system operation is greater than ever: It has to be as intuitive, uniform and simple as possible — just like a smartphone — so as not to overwhelm the operator.

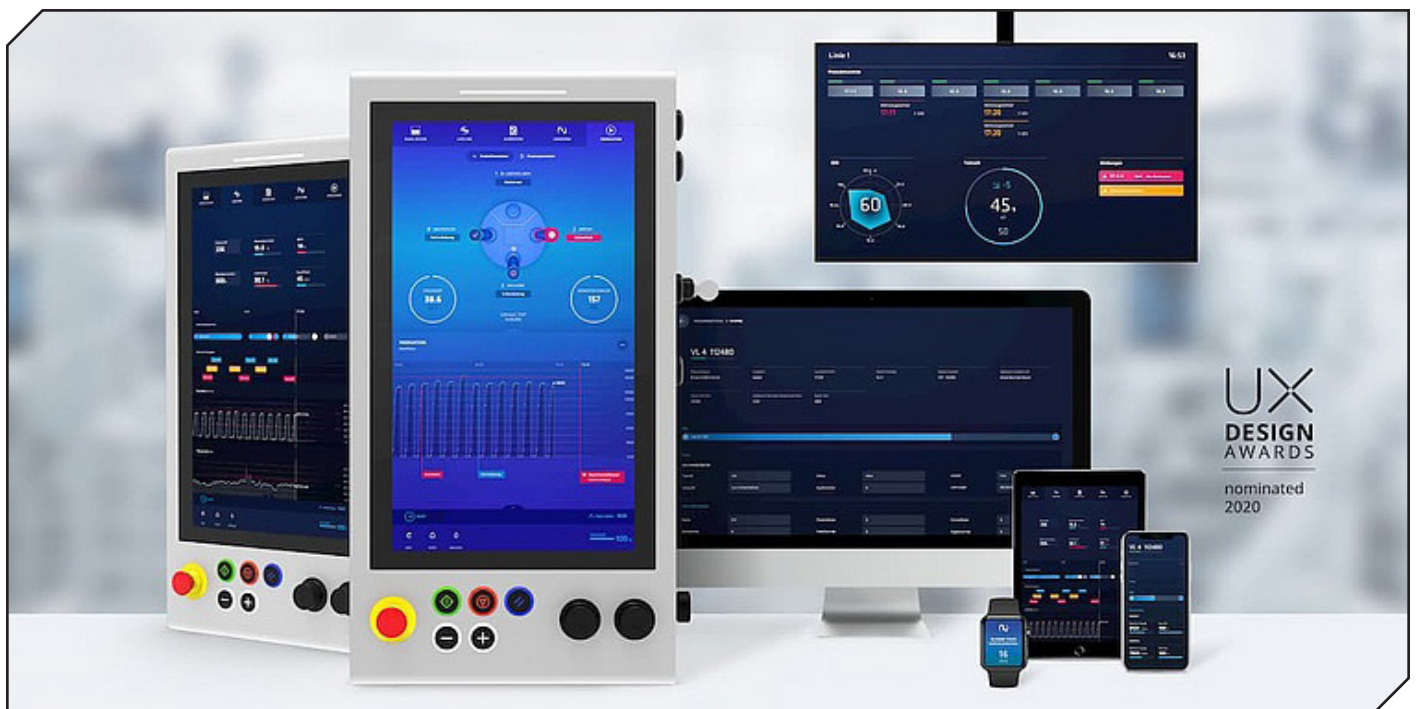
Extensive networking, self-explanatory operation — with this goal in mind, the EMAG Group started developing EDNA (which stands for EMAG DNA) three years ago, with the help of various partner companies. The entire process was very sophisticated and ambitious, as the EMAG Group consists of many subsidiaries that all specialize in different technologies and applications. Together, they develop complex manufacturing systems provided to a customer entirely from a single source. With that in mind, the envisioned ecosystem had to benefit all EMAG solutions as a uniform operator interface and IoT machine core. “Therefore, we discussed the requirements in a series of workshops and coordinated each development step with experts from the EMAG companies,” explains Peter Strohm, business development manager IoT at EMAG.

The solution has been available for a while now, and has won over its initial users: feedback is showing that using

EDNA significantly increase OEE. “With this research, we estimate that a return on investment is possible after about a year — if the collected data is analyzed and used to plan future actions,” says Strohm. But how exactly are these successes possible?

1. IoT Core: Bridge to the Smart Factory

First, let’s take a look at the EDNA IoT CORE of EMAG, with the diverse options for expanding it with hardware and software components: The EDNA CORTEX software runs on the powerful industrial PC and makes data available using various protocols, such as MQTT and REST, or — in the future — OPC-UA. With EDNA CORTEX, production data is processed, aggregated and analyzed. It is possible to flexibly adapt the scale on which the IPC is used: only locally within a standalone machine, connected to an edge solution of the company or networked with the cloud. At the same time, the solution has a completely modular software architecture that can be implemented in the specific IT infrastructures of the EMAG customers. “The solution is completely open and offers various standard





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interfaces. Connecting additional sensors, for example vibration sensors, and integrating products from other machine manufacturers is no problem,” emphasizes Strohm.

As a result, users can access a large range of value-added applications. This currently includes the following apps: “Parts Quantity Forecast” (estimated output quantity per shift), “Cycle Time Monitor” (current cycle times of machines or lines), “Smart Tool Change” (information on remaining tool life), “OEE Monitor” (detailed breakdown of current OEE) as well as apps for checking “machine health” (condition of the axes) and “machine status” (traffic light system signaling readiness for operation). “All in all, users get a more comprehensive overview of active production. Another significant point to keep in mind is that many more possibilities will open up in the future,” explains Strohm. “The range of available apps is constantly being expanded and data analysis is becoming more and more comprehensive. And this means: Added value is created for the customer and is immediately

noticeable in the form of increased productivity. The approach is future proof and easy to implement.” The latter also applies to the question as to which EMAG machines are compatible with all of this: From retrofitting of virtually any model from the past two decades to integration into new machines, everything is possible. Another feature of EDNA is our new concept for operation using an intuitive HMI, which is now available for the MIND-L 1000 induction hardening machine from EMAG eldec. The roll-out for other machine technologies at other subsidiaries is in progress.

2. Smartphone Like Dashboard

Of course there are questions regarding the usability of the entire approach — and the term “app” is already a good first sign: The front-end design of the EDNA Life Line dashboards is based on modern tablets and smartphones. “Users already know the underlying operating philosophy from their daily lives. This means that they can learn how to use the operating interface much faster, which in turn has a

positive effect on process reliability,” explains Ricarda Schuhmann, who is responsible for design and strategy at intuity, one of EMAG’s development partners. A first glance the dashboard immediately confirms this assessment: Data is presented in appealing visualizations in individual widgets. Users can determine what exactly is shown and in which layout. The clear structure pays off — quite literally: Early warnings are signaled for anomalies, the end of tool lives or machine wear. This prevents overlooked rejects and unplanned downtimes. Production planners, operators and others have access to the dashboard from anywhere — for example on their smartphone. “Three basic principles governed our joint development: simplicity, consistency and networking,” adds Lukas Siegele from intuity. “The end result embodies these principles in every respect. It lays the foundation for the chaotic and fully networked production of the future.”

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Lucifer Furnaces recently supplied a Top Loading Furnace to a leading tooling manufacturer. Model TL7-481818 has a chamber size of 48" H x 18" W x 18" L and heats to 2,300°F. Heavy gauge, coil wound, low watt density heating elements in 6 removable holders are controlled as 3 separate zones to provide uniform heating. The furnace chamber is insulated with 6½ inches of multilayer insulation for energy efficient operation and low outside shell temperature. The hinged doors are insulated with 5" thick pyro-bloc insulation. Controls include a Eurotherm Nanodac/Honeywell master/slave arrangement. In addition to the top loading door, the furnace is designed with a side door for easy service access into the chamber. This furnace joins a 2nd Lucifer Furnace already in use for the production of dies to cut fabric to make N95 masks for the medical industry. These furnaces are completely wired, assembled, and shipped ready for connection to a main power supply.

For more information:

Lucifer Furnaces
Phone: (800) 378-0095
www.luciferfurnaces.com



Dillon Manufacturing

OFFERS CHUCKS FOR VARIOUS WORKHOLDING APPLICATIONS

Dillon Manufacturing offers their full line of chucks for various workholding applications. Application chucks such as the universal ball lock power chuck can grip the ID or OD of castings or forgings and have jaws which pivot up to 5-degrees for a firm grip on uneven surfaces. Inside or outside draw down chucks, which are sealed to prevent chips and coolant from entering the chuck body, pull the workpiece down to location for superior accuracy, especially on parallel and perpendicular surfaces. Auto-indexing chucks, with positions of 4x90° or 8x45°, machine multiple surfaces in a single clamping. Retractable jaw shaft chucks, which machine shafts in a single clamping operation, allow jaws and face drivers to be changes so that different shaft sizes can be machined. Additional application chucks available include inside or outside pin arbor chucks, inside clamping mandrels, outside collet chucks, diaphragm chucks,

gear chucks, finger chucks, compensating chucks, and aluminum wheel chucks.

Dillon application specialists are experienced in workholding requirements for many industries, and are available to assist with chuck and jaw selection.

Like all Dillon products, their chucks are made in the USA in ISO 9001:2015 registered facilities.

For more information:
Dillon Manufacturing, Inc.
Phone: (888) 909-0894
www.dillonmfg.com



MASTA 10

NEXT GENERATION CAE SOFTWARE FOR THE DESIGN, ANALYSIS AND OPTIMISATION OF TRANSMISSION SYSTEMS



DESIGN



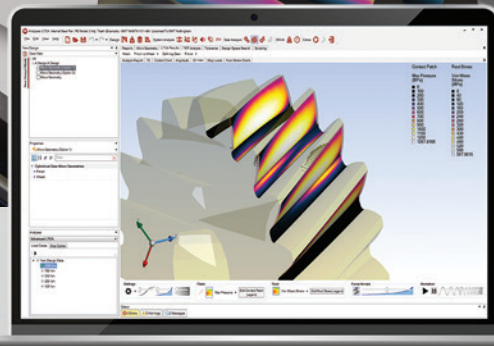
ANALYSE



OPTIMISE

- Design gearbox and driveline systems from clean sheet or imported concepts
- Run and generate reports on a wide variety of analyses including static deflections, durability, efficiency, frequency domain NVH, time domain dynamics and more

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