

## Press Release

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## The METAV 2014 showcased up-to-the-future technologies

**Innovative production technologies for increasing productivity and optimising resource utilisation**

### Technical closing report on the METAV 2014 from 11 to 15 March 2014

**Frankfurt am Main, 30 April 2014.** – The METAV 2014 gave its visitors an overview of up-to-the-future technologies. Under the vision of Industry 4.0, numerous solutions were showcased that map out the opportunities offered by new process chains. The huge potential of additive production processes has meant that some exhibitors have already premiered processing machines with which 3D printing is possible under industrial conditions. With what are called hybrid machines, material can be applied and a finishing operation performed in a single machine. Another major focus was medical technology, where solutions along the entire process chain were presented, beginning with 3D scanning all the way through to actual production.

In addition to the above-mentioned trends, the exhibitors showcased design enhancements for established machining concepts. In this context, upgrading the flexibility and the machining quality has become a major focus. Expanding industrial sectors like power generation are posing progressively tougher

requirements for the efficiency of machine tools used for manufacturing the components involved. Sophisticated materials used employed in the aviation industry necessitate the development of modified machining strategies. In addition, the general shortening of product lifecycles demands software-based aids for shortening the development time of processes. Manufacturers exhibited numerous products designed to solve these and other problems. Trending topics were additionally addressed in the supporting events. Examples of these trends are provided below.

### **Additive production processes**

#### Rapid.Area – Generative production from design to the finished product

In order to keep pace with the increasing importance of additive production, the topic was addressed at the METAV 2014 in a special show. Typical applications were presented, plus perspectives for the future and the solutions currently available.

Sauer GmbH Lasertec, Pfronten, exhibited a five-axis machine called “Lasertec 65 Additive Manufacturing”, with which laser deposition welding and metal-cutting post-machining are possible. Here, the metallic powder is fed in through a nozzle, and melted using a laser. According to the manufacturer, various metallic powders like steel, nickel or titanium can be processed. Metal-cutting post-machining in a clamped configuration enables component contours to be created step by step. In addition, the process can be used for repairing damaged components.

RTC Rapid Technologies GmbH from Hofheim am Taunus exhibited a 3D printer for producing plastic components, in the shape of the “Objet500 Connex3” from Stratasys. Thanks to the patented simultaneous “Multimaterial-Polyjet technology”, 3D models can also be produced with different materials. Here, for the first time, differently coloured photopolymers can be processed, and 3D models produced, for example. In this process, liquid plastic is fed into the printing heads and warmed up, so as to achieve a higher viscosity. The material is deposited in 0.016 mm layers. After being

deposited, the liquid plastic is hardened by UV lamps attached to the printing head. Overall, the process is seen as very important for fast production of an initial prototype.

#### Systems for laser beam melting

Additive production processes were directly spotlighted not only at the special show, but also at individual companies. SLM Solutions GmbH from Lübeck exhibited a laser beam melting system, which enables metallic materials, such as titanium, Inconel, stainless steel or aluminium, to be processed. Thanks to the relatively low process temperature of under 500°C and the high degree of purity exhibited by the molten materials, of 99.7 per cent, comparable characteristics are achieved to those accomplished with conventionally produced materials. The system exhibited enables additive laser melting to be carried out in a space measuring 500 x 280 x 325 cm<sup>3</sup>. Here, four fibre lasers each illuminate the powder bed in two units using a 3D scanning unit. The metallic powder is fed in through a continuous delivery system. The Rapid-Prototyping-Software Magics AutoFab integrated as a standard feature enables numerous CAD formats and STL data to be read in.

#### Hybrid machine tools featuring MPA technology

Maschinenfabrik Berthold Hermle AG from Gosheim presented an alternative process to laser sintering in the shape of the MPA technology. This involves a form of thermal injection, in which powder particles are accelerated to very high speeds using a carrier gas and directed onto the substrate with a nozzle. Due to local pressures of 10 GPa and temperatures of up to 1,000°C, the particles are deformed at impact, thus creating a solid material composite. Integrating the unit described into the C40 standard machining centre enables the layers applied to be finished at will. The NC program is generated by a CAM software package called MPA-Studio, developed specifically for this application. Hot-working steels, stainless steels, heavy metals (pure copper, bronze) and light metals (titanium, aluminium) can be machined.

## **Removal laser technologies**

Besides its role in additive production processes, laser technology is also used for removing material. Acsys Lasertechnik GmbH from Mittweida showcased solutions for engraving and structuring component surfaces. One typical application is the insertion of lettering into a manufactured shape. The material removal here is 0.5 - 2 µm. This process is used to structure functional surfaces for medical technology applications or for air-bearing spindles. In addition, chip break geometries can be created at metal-cutting tools. Since the hardness of the tool's cutting material in laser machining is unimportant, diamond tools can also be processed. The surface quality on the faces being machined lies at  $R_a = 0.4 \mu\text{m}$ .

## **Enhanced efficacy in production operations**

### Modified tools for more effective machining

Design enhancement of the tools used constitutes a continual challenge for machine tool manufacturers. Gühring KG from Albstadt exhibited a milling tool that can be used for drilling as well up to an l/D ratio of 2. This tool, with the brandname "Driver", is furthermore suitable for manufacturing ramps with very steep plunging angles of up to 45°. This improved operational behaviour results from an optimised face geometry, a modified chip space and appropriate preparation of the cutting edge.

Another way to optimise tool deployment is more effective utilisation of the blades in multi-fluted indexable inserts. In industrial applications, often not all the blades are used, since the wear status, particularly after shift changeovers, cannot be precisely determined. In order to meet and master this problem, two Asian tool manufacturers presented their concepts for assuring effective utilisation.

Under the term "Easy Selection", MMC Hartmetall GmbH from Meerbusch exhibited hard-metal indexable inserts for metal-cutting jobs on steel and cast materials, and on super- and titanium alloys. Here, the letter P, M, K or S was engraved on the plate to indicate the application class involved. In addition,

the tools are colour-coded for differentiation. Furthermore, the inserts are identified with the letters L, M and R for finishing, medium machining and roughing.

ZCC Cutting Tools Europe GmbH from Düsseldorf, under “simply coloured”, presented a concept in which the application class is identified by a coloured marking on the clamping bore. In addition, the blades are themselves colour-coated to designate the cutting material, thus enabling the operator not only to identify them easily, but also to detect wear and tear. In this way, the operator finds it easier to determine which blades have already been used.

### Versatile machines

The integration of several different machining steps on a single machine continues to constitute a major focus. At the METAV 2014, numerous machines were presented with which different machining operations can be run, with concomitant savings in terms of make-ready and non-productive times.

Emag Maschinenfabrik GmbH, Salach, exhibited a vertical precision machining unit in the shape of the VLC 100 GT. This machine combines the hard-turning and grinding processes. In addition, the company is endeavouring to integrate the honing function. The workpieces are fed into the pick-up machine automatically over an endless conveyor belt.

WFL Millturn Technologies GmbH & Co. KG from Linz, Austria, showcased a complete processing machine for complex components. This machine can perform not only the various turning, milling and drilling operations, but also grinding and honing processes. In addition, gears can be produced. To determine the quality of the contours created, measuring heads can be integrated for in-process measurements.

### Flexibility with large machines as well

The flexibility of machine tools is already the state of the art in the commonly encountered machining sizes. When it comes to machining large components, however, e.g. in power engineering systems, special machines are used. The trend towards a shorter machining time and tougher stipulations for accuracy, though, leads in this category as well to integration of several different machining steps in a single machine.

Bimatec Soraluze Zerspanungstechnik GmbH from Limburg a. d. Lahn showcased a travelling-column machine, which is conventionally suitable for milling jobs. In the modification exhibited, the machine features a carousel turntable. This means that turning and grinding operations can also be performed on workpieces with a maximum diameter of 2,100 mm. Since the carousel turntable is embedded in a longitudinal table, components can be milled on a length of 4,000 mm.

### New requirements for process materials

The efficiency of a machining process depends not only on the machine and the tool involved, but also on the process materials being used. Of particular importance in this context are the cooling lubricants, which cool and lubricate the working area during chip removal and additionally help to remove the chips. To enable them to perform these tasks, water-mixable cooling lubricants possess various additives. Since these additives may result in an unwanted environmental impact and affect the operator's health, there are ongoing efforts throughout the EU to limit the use of suitable additives.

Oemeta Chemische Werke GmbH from Uetersen exhibited a cooling lubricant free of boron and biocides, which means it meets the statutory stipulations applying as from 2015. This cooling lubricant, called Novamet 920, contains surfactants as a replacement, which inhibit the formation of biofilms. In relevant tests using fungal spores and bacteria, no growth could be detected after a period of 25 weeks. In addition, according to the manufacturer, the coolant exhibits good wetting capabilities, which means the process is more

effectively cooled and lubricated. In further tests, the product's good skin-compatibility was confirmed.

## **Medical technology**

### Metal meets Medical "smart solutions – more efficiency"

Medical technology is a fast-growing market for mechanical engineering firms. The entire process chain involved for manufacturing instruments, implants or prostheses is a highly challenging one, compared to conventional machining jobs. The solutions usually have to be designed so as to enable operators even without any technical training to manufacture components. The entire process chain was showcased within the framework of a special show at the METAV 2014.

In the shape of the DS20, Renishaw GmbH from Pliezhausen exhibited a 3D dental scanner. Here, light patterns are projected onto the measured object using white-light laser systems. The surface is then computed using the image data from two cameras and converted into CAD data. The time required for measuring a set of dentures is about two minutes; the accuracy achieved is +/- 10 µm. If a higher accuracy has been stipulated, the same manufacturer offers tactile dental scanners. Here, the surface is physically scanned, which gives an accuracy of approx. +/- 1 µm. In the shape of "Renishaw Dental Studio", moreover, a CAD software package is offered with which both scanners can be operated simultaneously. In this way, the jaw can be scanned and the individual stump accurately scanned in tactile mode.

Citizen Machinery Europe GmbH, Esslingen am Neckar, exhibited an automatic lathe called M16, for machining rotationally symmetrical components. The driven tools are fitted with a B-axis as a standard feature, which possesses a slewing angle of 135°. This tool concept enables both the front and back sides to be machined. With a rapid-traverse rate of 32 m/min., the non-productive times can according to the manufacturer be reduced by 30 per cent. Typical components from the field of medical technology that can be processed using this machine are medical tools.

The starting materials for the typical application described in the preceding paragraph are produced, for example, by Forecreu Biométal from Malicorne, France. The company manufactures cannulated round rods from stainless steel, special steel and titanium for biomedical applications, and likewise showcased its capabilities at the METAV 2014. The outer diameter of the round rods described ranges from 5 to 17.5 mm with an inner diameter of 0.9 to 3.6 mm.

#### Inaugural meeting of the Medical Technology Working Group

The major importance of medical technology for the mechanical engineering sector has been spotlighted by the new Medical Technology Working Group in the VDMA. The companies participating met for the inaugural meeting under the aegis of the METAV: here, the particular perceived importance of this sector, the challenges it faces, and its successes so far were presented.

Kuka Laboratories GmbH from Augsburg elucidated the challenges involved in changing from a mechanical engineering company pure and simple to a medical technology producer, as exemplified by its own experience. The company has, for example, developed a design with which CT images can be prepared during an operation. The system provides fast movements and multifarious positioning options, so that the doctor concerned can be effectively supported during the operation. When these technologies are used in medical applications, new requirements apply, e.g. in terms of sterility, traceability or safety, all of which have to be met.

#### **Enhancing the efficiency of established machining concepts**

##### METAV Technology Forum – “Tools and Surface Technology”

The increasingly stringent requirements applying for industrial components are leading to the development of new, sturdier materials. Metal-cutting machining of these materials was illuminated under the aegis of the Technology Forum “Up-to-the-future machining processes”. Gühring KG, Albstadt, presented its concept for holistic optimisation of drilling tools for machining Inconel. Here, the stresses encountered are simulated, and the



tool concerned is optimised in terms of the cutting material, the coating and the shape. In regard to the coating, the “Signum” layer was spotlighted, which consists of a nano-layered layer system based on (TiAlSi) N - (TiAlX) N and exhibits a hardness of 5,400 HV. In addition, the coating is oxidation-resistant up to 800°C, which underlines its suitability for machining high-strength nickel-based alloys.

Sauer GmbH Ultrasonic presented a milling machine concept in which an axial oscillation is superimposed on the rotational movement of the spindle. It lies between 20 and 50 Hz. The application known so far is grinding of very brittle materials like ceramics, of the kind used in medical technology, for example. In addition, the firm highlights the potential for milling fibre composite materials and metallic materials of high thermal stability. Improved chip breaking was evidenced when machining the titanium alloy Ti-6Al-4V. The smaller chips can be more easily removed from the working area, enabling the blade to be more effectively cooled.

Machining materials with low thermal conductivity poses especially stringent requirements for the cooling concept used. When machining titanium- and nickel-based alloys, high-pressure cooling has meanwhile become industrially established as an alternative to conventional flooding-mode cooling lubrication. With the “CryoTec” technology, Walter AG from Tübingen presented the industrial implementation of a cryogenic process cooling system, using CO<sub>2</sub>. After being liquefied under pressure, the gas expands at the nozzle’s outlet at the tool holder, and thus cools down to about -8 °C. The resultant cooling effect brings about an effective removal of heat from the working area. In the studies presented, the useful lifetime when milling X22CrMoV12.1 martensitic steel was increased by 30 per cent in comparison to minimal-quantity lubrication. The temperature at the cutting edge was reduced by 100°C.

### Dortmund Grinding Seminar "METAV Spezial 2014"

Precision machining of surfaces is gaining steadily in perceived importance. Grinding or finishing operations enable the surface qualities to be improved and the tribological characteristics optimised. An overview of the new trends and developments in this field was provided by the Dortmund Grinding Seminar.

Under the name of Cubitron II, 3M Deutschland GmbH from Neuss showcased a new generation of abrasive grains, which thanks to their triangular structure enable defined machining to be performed. When grinding is carried out using conventional grinding disks, material removal produces furrows. In the solution now presented, material removal is defined, producing flow chips. In a typical application presented by Liebherr Verzahntechnik GmbH from Kempten, the grinding time for grinding tooth flanks was reduced from 66 seconds when using a conventional grinding disk to about 28 seconds with the innovative abrasive grains. In addition, the risk of grinding burn from lowering the process temperature was reduced.

Another innovative grinding disk was premiered by Saint-Gobain Winter Diamantwerkzeuge GmbH & Co. KG from Norderstedt. Under the name of "Paradigm", a new type of bonding has been developed on a metallic basis, in which high porosities of 46 per cent have been achieved. In a typical application for flute grinding, the grinding time was reduced by 36 per cent and the machine's power consumption by 50 per cent.

Supfina Grieshaber GmbH & Co. KG from Wolfach exhibited a newly developed finishing process, in which the tool is with piezo support induced to oscillate in a radial, tangential or axial direction. The span here is 30 to 60 µm at a frequency of 100 to 200 Hz. Oscillation in a radial direction enables structured surfaces to be created, on which the individual striations are not interconnected. In the resultant recesses, lubricating media can collect, so that this surface structure is particularly suitable for tribologically stressed components.

The creation of defined cutting edges is of major importance in the manufacture of turning, drilling or milling tools. The blades are here provided with a uniform rounding. In addition, coated cutting edges are post-treated. In this regard, Magnetfinish GmbH from Stans, Switzerland, showcased a solution for rounding off cutting edges on micro-tools. This process principle enables blades of milling and drilling tools with a diameter of as little as 0.5 mm to be rounded off. In this process, two magnetic heads, between which an abrasive-acting powder moves, are rotated in the same direction. When tools are held in the intermediate space filled with powder, sharp-edged blades are rounded off.

In order to cool the grinding process effectively, and to reduce the risk of grinding burn, Blaser Swisslube AG from Hasle-Rüegsau, Switzerland, and Fritz Studer AG from Steffisburg, Switzerland, showcased a concept for optimised cooling lubricant feed. Taking due account of grain size and grain interstices the actual requirement for cooling lubricant is calculated. By means of special nozzles, this is directed onto the working area using an increased pressure. As a result, both the tangential force and the spindle speed could be reduced. This goes hand in hand with reduced energy consumption.

#### Forum Clamping Technology “Optimal machining processes through innovative clamping technology”

Under the aegis of the Clamping Technology Forum, innovative clamping systems were shown, enabling the efficiency of the machining process to be enhanced. Schunk GmbH & Co. KG from Lauffen am Neckar exhibited an innovative chuck concept for clamping rotationally symmetrical workpieces, whose own weight has been reduced by 60 per cent compared to conventional solutions. This chuck, brandnamed “Rota-S flex”, offers a high degree of flexibility for clamping very large and very small parts on vertical lathes.

For clamping more complex contours, Römheld GmbH Friedrichshütte from Laubach exhibited an innovative zero-point clamping system, comprising

different clamping elements that serve as a support for defined surfaces. One noteworthy feature here is the high degree of flexibility provided, as exemplified by an engine mount. This clamping concept can, for example, be used for clamping 4- and 6-cylinder engine mounts.

WTE Präzisionstechnik GmbH from Ehrenfriedersdorf exhibited a clamping concept for tools in which the advantages of hydraulic and shrink-clamp chucks are combined. With these HPH universal clamping chucks, up to 20 per cent higher torques can be transmitted. At the same time, a high degree of thermal stability is assured.

As a vendor of automation systems, Andreas Maier GmbH & Co. KG from Fellbach exhibited solutions for automating the loading of workpieces into the machine and unloading them again. Thanks to a cassette push-feed magazine with an associated gripper, relatively small parts can be fed into the machine from relatively large packs. The maximum carrying capacity of a cassette here is 50 kg, the push-feed speed can be up to 300 mm/s. The drive system utilises compressed air with an operating pressure of 5 bar. In addition, the shape and the dimensions can be flexibly modified.

## **Industry 4.0**

### Congress themed around “On the way to Industry 4.0”

The importance of computer-aided manufacturing has risen continuously over recent years. The shortening of product lifecycles necessitates the implementation of new technologies in the planning and design of production processes. Under the vision of “Industry 4.0”, new technologies are grouped together whose use can dramatically shorten the time elapsing between the original idea and commencement of series production. The existing and future solutions were discussed at the METAV within the framework of a specially themed conference.

The WZL (Laboratory for Machine Tools and Production Engineering) from Aachen spotlighted in its own contribution the shortening of the production time and the length of the process chain. When a product is being

manufactured using a laser melting process, for example, a reduction of 90 per cent in the production time can be anticipated in comparison to conventional production methods. Shortening the length of the process chain is explained by citing the example of incremental sheet-metal forming, where a reduction of 85 per cent can be achieved.

Scheidt & Bachmann GmbH from Mönchengladbach showed in its own contribution how far Industry 4.0 is being reflected in the networking of automobiles. Whereas in 2012 only 3 per cent of automobiles were fitted with an internet link, in 2020 the figure will be approximately 22 per cent.

#### Virtual and augmented reality

The use of new computer-aided technologies for reducing the times required for process development and production planning is gaining steadily in perceived importance. They enable processes to be simulated or production equipment to be virtually imaged.

Siemens Industry Software GmbH & Co. KG from Cologne presented a solution for adapting a digital machine to a control system. Here, the commands from the control system are virtually converted by a computer into traversing movements. By adding an NC controller to the CAM system, the simulation can be performed on the basis of the actual control system software. Machine-referenced data can be inputted here, so that the movements, speeds, accelerations, tool changes and cycle times behave in the simulation just like in the actual machine. This means that problems which may occur during machining are detected at an early stage.

The Hommel Group from Cologne exhibited under "Machine 4.0" a tool for planning and conceiving production facilities. An app can be used to depict various machine models of the Okuma type in an existing machine hall. Here, the virtual and real environments are brought together, enabling the space required and the optics to be estimated with greater accuracy. The position of the machine is fixed by a marker, which is targeted with a smartphone or a

tablet. In the unit's camera mode, the machine selected in each case is then also imaged next to the hall. There is furthermore an option for obtaining a view inside the machine room, so that a basis for discussion is on file as to which machine is best suited for your own company.

### CAD/CAM software

For 5-axis machining, the use of a CAD/CAM software package for optimising the traversing paths of the tools used is meanwhile state of the art. In turning processes, this kind of software is dispensed with, by reason of the simple kinematics involved. Machining high-strength special materials, however, leads to new solutions in this category as well.

InterCam-Deutschland GmbH from Bad Lippspringe has developed a CAD/CAM module for dynamic turning in grooving operations. When wide grooves are being produced, the usual method is to gradually engage with a grooving tool, and traverse in a longitudinal direction. The tool bits used are subject to increased wear and tear, particularly in the case of radial feed. For this reason, a software package has been developed that optimises the approach movement. Thanks to the softer chamfer of the tool, grooving operations are avoided. The useful lifetime can, according to the manufacturer, thanks to the reduced cutting pressure be increased by up to 300 per cent.

### Optimised planning of production operations

Higher product diversity demands a flexible reaction to delivery bottlenecks or short-term fluctuations in demand. Production planning often has to be changed at short notice. In this context, the avoidance of standstill times at individual production lines is a very complicated matter.

Proxia Software AG from Ebersberg showcased an MES (Manufacturing Execution System) software package with which production planning can be simplified. The systems concerned are continuously monitored and any non-compliances in the cycle time are analysed. This enables technological problems to be discovered and organisational planning of future orders to be

influenced. By networking with an ERP system, the following orders are analysed and alternative production schedules mapped out. In this way, the standstill time of the equipment can be effectively minimised. The company is here creating software solutions that are responsively tailored to the particular requirements of the company concerned.

### **Quality Road**

The exhibitors from the field of metrology were at the METAV 2014 for the first time grouped together in a shared area. What was called the Quality Road gave the visitors a comprehensive overview of the new developments achieved for qualitative and quantitative evaluation of process results.

Under the name of “Mach Ko-ga-me”, Mitutoyo Deutschland GmbH, Neuss, exhibited an online coordinate measuring instrument. This device is intended specifically for integration into a concatenated line. With a maximum traversing speed of 340 mm/s and an acceleration of 6,750 mm/s<sup>2</sup>, components can be measured in short cycle times. The device is able to measure components featuring a maximum length of 120 mm with a resolution of 0.02 µm. Measurements can be taken both with tactile-scanning and tactile-switching measuring heads.

Keyence Deutschland GmbH, Neu-Isenburg, presented a digital measuring projector. The device enables the dimensional stability of components to be checked very quickly. Thanks to an automatic pattern search function, the workpiece does not need to be aligned before measurements are taken. The projector is able to determine up to 99 features simultaneously, and check for compliance with the tolerance limits. The time required for this is 5 seconds or less. The same manufacturer showcased a 2-axis LED micrometer. This metrological system is suitable, for instance, for determining the diameters of wires being manufactured on drawing lines. On average, an accuracy of +/-2 µm is achieved in a diameter range of 0.3 mm to 30 mm. Measurements are taken at a scanning frequency of 16,000 scans per second.

Hexagon Metrology GmbH from Wetzlar exhibited measuring instruments capable of both optical and tactile measuring modes. With the “Optiv” range of multi-sensors, workpieces can be measured in a clamped configuration using different sensors. Besides tactile sensors, optical sensors operating with white-light technology, laser technology or with a CCD camera can be used.

### **Summary**

The exhibitors at the METAV 2014 showcased innovative solutions for production technologies geared to providing more efficiency and higher productivity. Besides the flexibility of the machines involved, support for the production operations by computer-aided systems was also a major focus. By using virtual machines and optimised CAM software, metal-cutting machining processes can already be imaged and optimised outside the machines. Additive processes for metalworking jobs were given more prominent priority on the stands of many exhibitors. These new technologies offer an option for creating any desired contours and structures. For medical technology and the aviation sector, in particular, the advantages are manifest. To sum up, the METAV 2014 thus tightened the focus on current and future trends, and provided an overview of the solutions so far available from the different categories involved, with a significant contribution coming from the numerous special shows and accompanying events.

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