PAMA

2015

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JOURNAL

BORING AND MILLING MACHINES AND MACHINING CENTERS

the partner
for demanding
customers

worldwide 1st
in boring

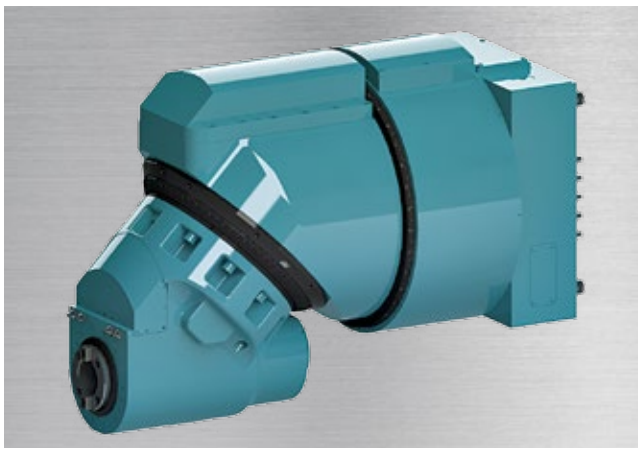
PAMA

a global name
in machining of
components

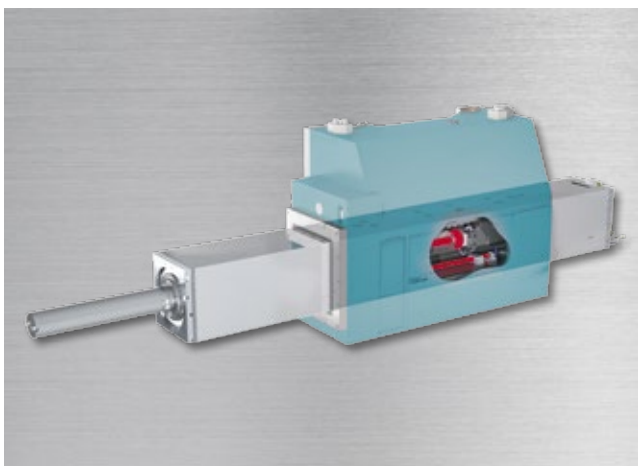
your
competent
solution
provider

NEWS 2015

SPEEDMAT HP
turning table



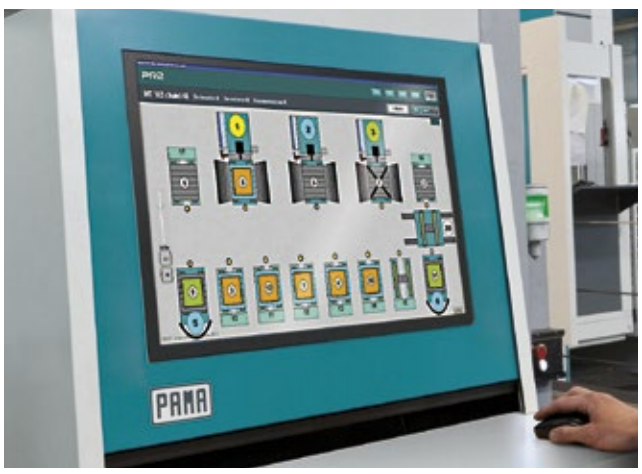
SPEEDMILL
milling machine



SPEEDRAM HP
direct drive

VERTIRAM
vertical machining centers

VERTIRAM
turning table TTH

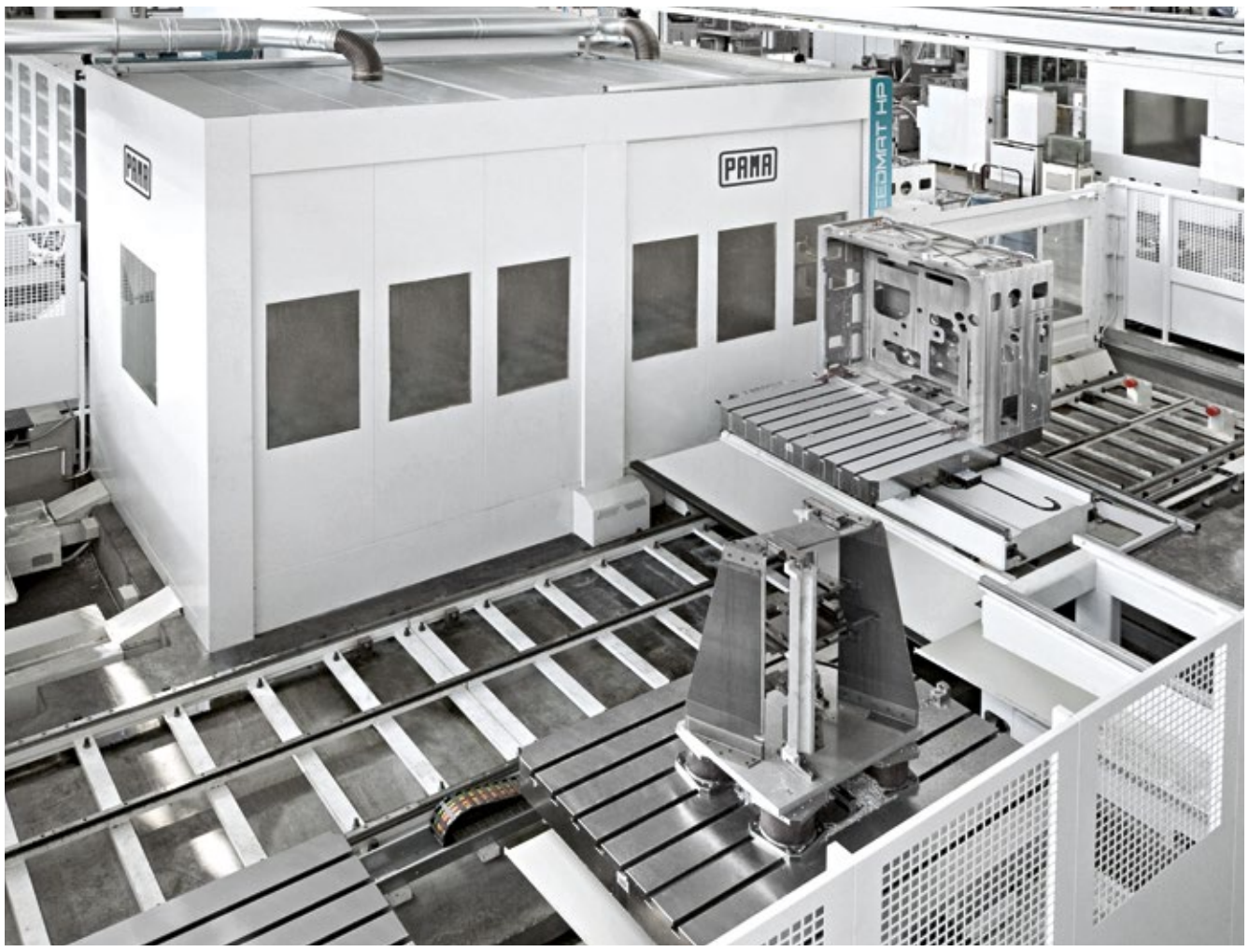


PR2 SUITE
predictive production management

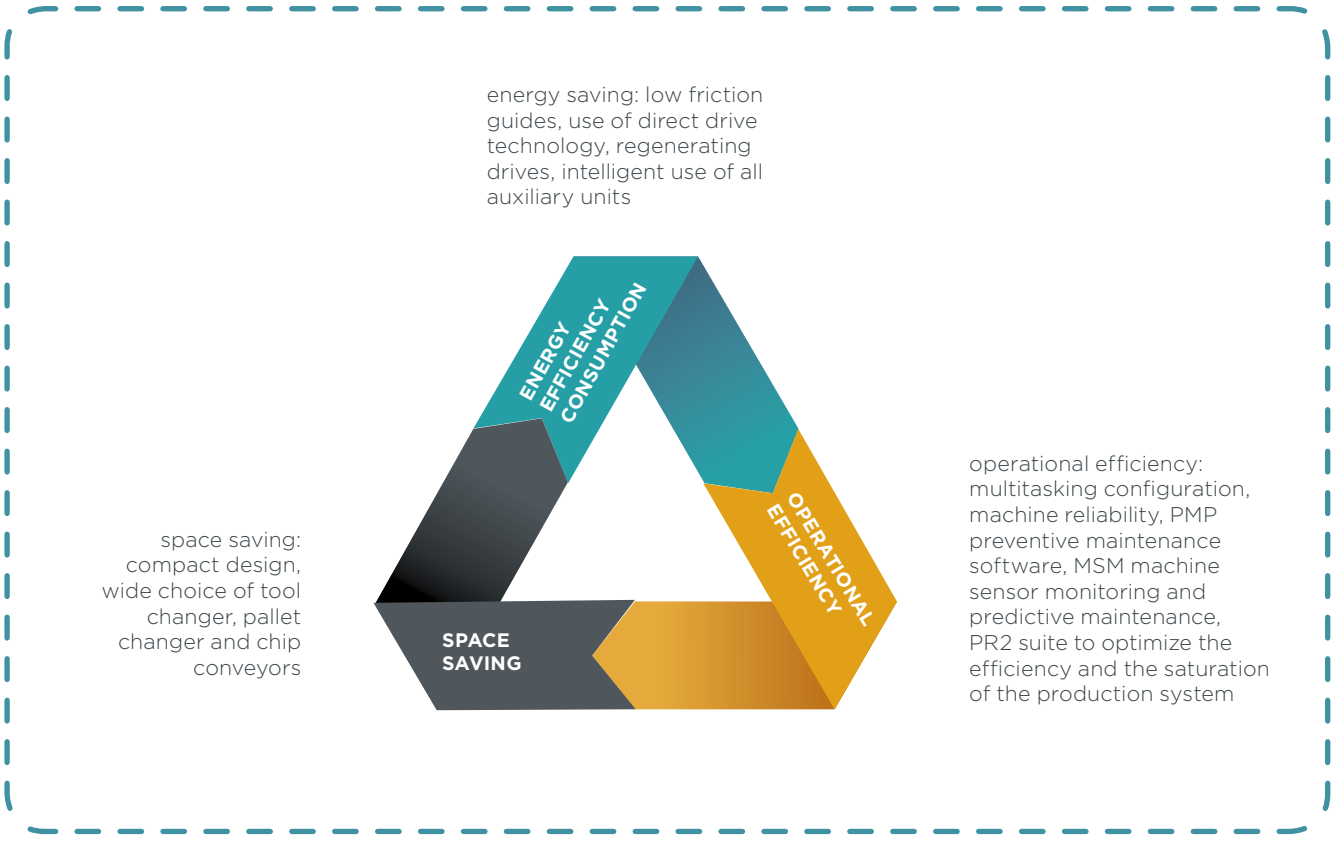
i-features

PAMA PRODUCTS: EVEN MORE RELIABLE, PRODUCTIVE AND EFFICIENT THAN EVER.

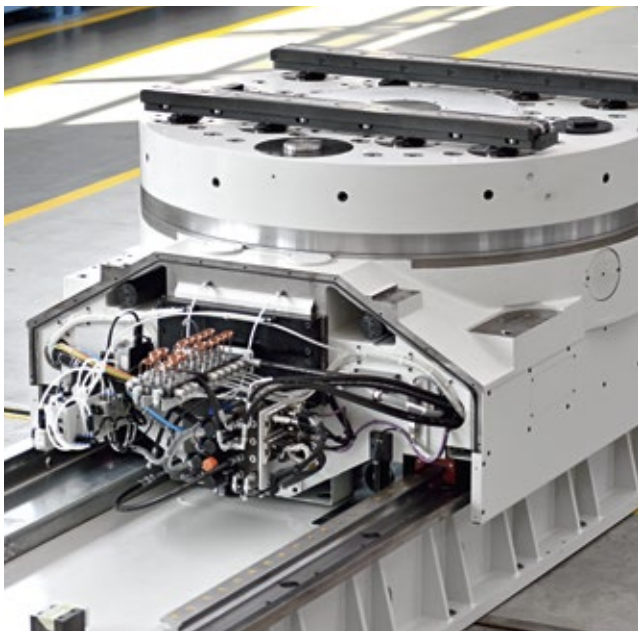
The continuous development, evolution and the improvement of its product range are the underlying values at the foundation of everything PAMA does. These values form a strategy that has now been in place for a number of years and has led the company to invest substantially in innovation, with a well structured and highly qualified R&D department conducting far reaching market analysis to effectively identify and forecast trends. This has culminated in the development of new products and evolution of existing products, to extend the technology and solutions encapsulated by PAMA i-features across the entire range.



The main goal for this overall evolution has been to increase the efficiency of the brand's different models, and, amongst other, to save energy. This is embodied in the concept **PAMA Global Efficiency (PGE)**. But this, however, is not limited to saving energy alone, which is in fact just one of the three pillars on which this strategy is founded, together with saving factory space and maximising operating efficiency.



Energy savings have been achieved through the use of highly efficient motors, regenerative drivers, optimised structural design, the use of low friction linear bearings and intelligent ancillary management.
Technological innovation and precision Extensive scope for customisation makes it possible to minimise space usage by defining the most appropriate configuration for the customer's needs: with a frontal or lateral pallet changer, static or chain type tool magazines, an extensive range of different travel options to cater for specific applications and intelligently laid out ancillaries.
Operating efficiency is achieved through a number of factors: such as multitasking solutions for complete machining cycles performed on board the machine, an obsessive approach to reliability, instruments to help achieve 100% process efficiency and cut setup times, and facilitate access for simpler maintenance.
The most important new multitasking solution developed by PAMA is the new series of roto-translating tables adopting the innovative, patented **THT (Turning Hybrid Table)** concept. By combining the advantages of rolling bearings with those of hydrostatic bearings, PAMA has created a table that offers unparalleled

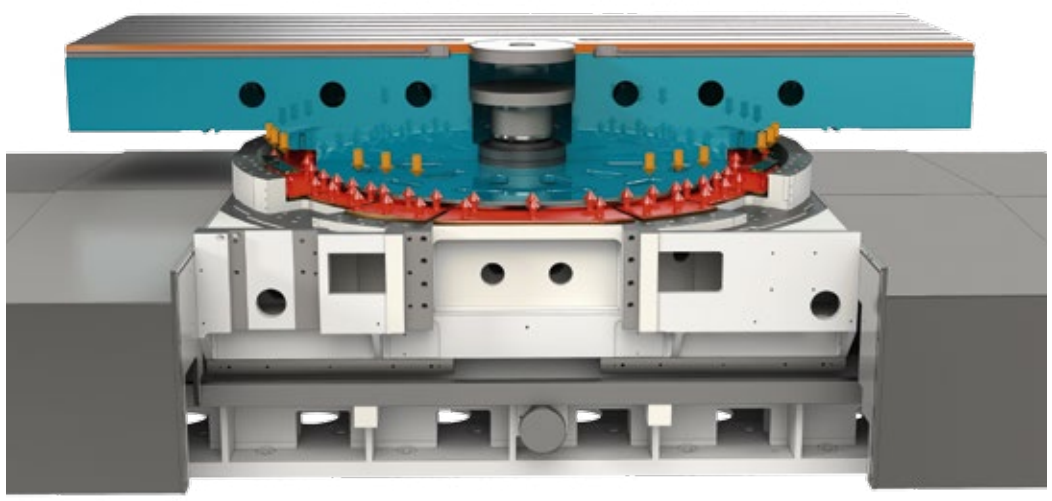


performance for both lturning - as it is not constrained by peripheral speed limits - and milling, with at least double the axial and tilting stiffness of a conventional table. This new technology makes the Speedmat HP machining centres capable of delivering the same turning performance as the best dedicated turning machines, but without sacrificing performance for milling, boring or 5-axis high dynamic machining tasks, finally making multitasking processes on the same machine a real advantage for the customer. But PAMA turning solutions include more than just horizontal spindle machines: for all situations where a vertical machining process is preferable, whether because of the shape of the piece and the specific machining processes necessary, or to cater for the requisites and preferences of the customer, the VERTIRAM series of gantry machines offers the ideal solution. Available as both moving table and gantry variants, these machines may be equipped with turning tables with different load capacities: the exclusive TRT tables with the THT technology mentioned previously may be used for loads up to 35,000 Kg while the additional TTH range of completely hydrostatic tables is available for working with heavier loads.

All horizontal spindle PAMA machines are equipped or may be equipped with TR or TH roto-traversing tables, with the linear axis supported on roller or hydrostatic linear bearings respectively. The rotating axis of both models uses the exclusive **PTB (PAMA Thrust Bearing)** hydrostatic thrust bearing, in which the bearing preload is achieved with peripheral carriers which distribute the load over a large diameter rather than with a centrally rotating bearing, completely eliminating the risk of table deformation. This solution gives the thrust bearing 50% greater tilting stiffness than a conventional hydrostatic bearing of comparable diameter.

The **HTC (Hydrostatic Tilting Compensation)** and **DOT (Dynamic Optimized Tuning)** packages have been developed to further improve the functionality of roto-traversing tables in extreme conditions. **HTC** is a patented intelligent system which automatically detects load imbalance and compensates for differences in pressure distribution on the hydrostatic thrust bearing with a dedicated servo-system. Although PAMA rotary tables are intrinsically extremely rigid, this system is paramount when the table is required to withstand high degrees of eccentricity, even when working with relatively light loads. Another problem often faced by tables of large machine tools is caused by variations in the moment of inertia of the piece which, even though the weight of the piece itself is comfortably within the capacity of the rotary table, may exceed the dynamic limitations of the B axis. This problem is most commonly encountered with boring and milling machines, where the outline of the piece may often project far beyond the boundary of the table. This is where the **DOT** system comes in, which automatically measures the moment of inertia indirectly and adapts the calibration parameters of the B axis accordingly, optimising velocity and acceleration. These system offer the customer greater freedom when setting up, making it possible to use the machine at its operating limits at all times without compromising safety or result quality.

A global leader in the boring machine sector, PAMA was the first to introduce the innovative and internationally patented **DSD (Direct Spindle Drive)** system on machines with a boring bar. As well as featuring on all the models of the Vertiram and Speedmill ranges, the benefits of this gearless technology are now also available on Speedmat HP machining and boring centres and on the new Speedram HP boring machine range, which joins the traditional Speedram family. The extremely high performance boring and milling spindle is invulnerable to interrupted cuts and ensures superlative quality finish even on drilled surfaces and with high speed rigid tapping processes. On Speedmat HP machines, this solution has made it possible to achieve exactly the same torque values as with a conventional gearbox system, but with higher rotational speeds. This solution is also another step forward for energy efficiency, with no drivetrain power losses, and



HTC (Hydrostatic Tilting Compensation - patented): automatically detects the bending moment created by uncentered loads and adjusts the pressure distribution of axial hydrostatic bearing (required in case of extreme bending moment with light axial loads).

i·features

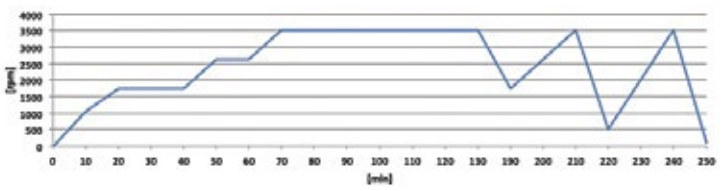
no power absorption due to oil circulation and filtration. The entire system is optimised for simple, quick maintenance, even though FMECA analysis has demonstrated that the solution is significantly more reliable than a conventional gearbox system, as it has drastically fewer parts.

The **HSS® (Hydrostatic Sliding Spindle)** hydrostatically supported boring spindle - a feature already available for some time on all PAMA boring spindles - is the perfect complement to DSD technology. PAMA has developed an entirely new and original interpretation of the hydrostatic boring spindle. This patented technology offers the most reliable solution available today. The result of this project is a boring spindle with absolutely no stick-slip and with perfect concentricity relative to the hollow spindle, and which also benefits from the significant damping capabilities of a hydrostatic system. The superlative quality standards of the PAMA mechanical machining department, which has extensively upgraded its machine pool in recent years, ensures the precision necessary to achieve perfectly uniform, extremely small annular spaces between the boring spindle and the hollow spindle and maintain very high assembly rigidity between the two components. Testifying to just how seriously PAMA takes innovation, this spindle range was extensively tested for more than two years on a production machine, to offer the end user the peace of mind of a totally dependable product.

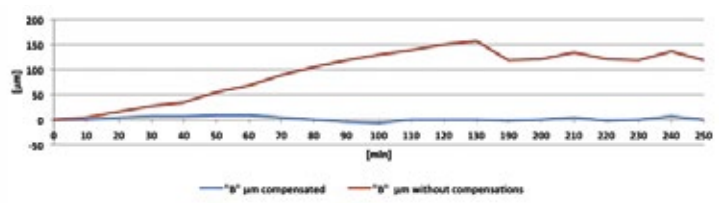
The precision of PAMA machines is renowned throughout the world. In addition to a painstaking design process to ensure the thermosymmetry of all structures, which is then verified using mathematical transient thermal analysis simulation programmes, and temperature stabilisation systems for

ATC (Automatic Thermal Compensation):
Real time CNC controlled compensation of spindle elongation / contraction by direct measurement (PAMA patent)

spindle speed



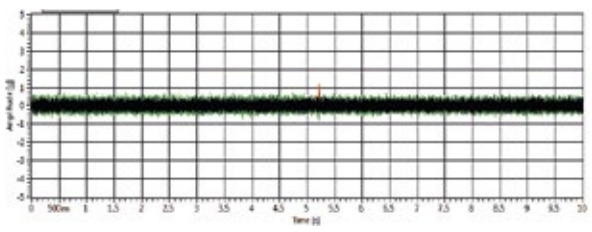
boring bar nose displacement



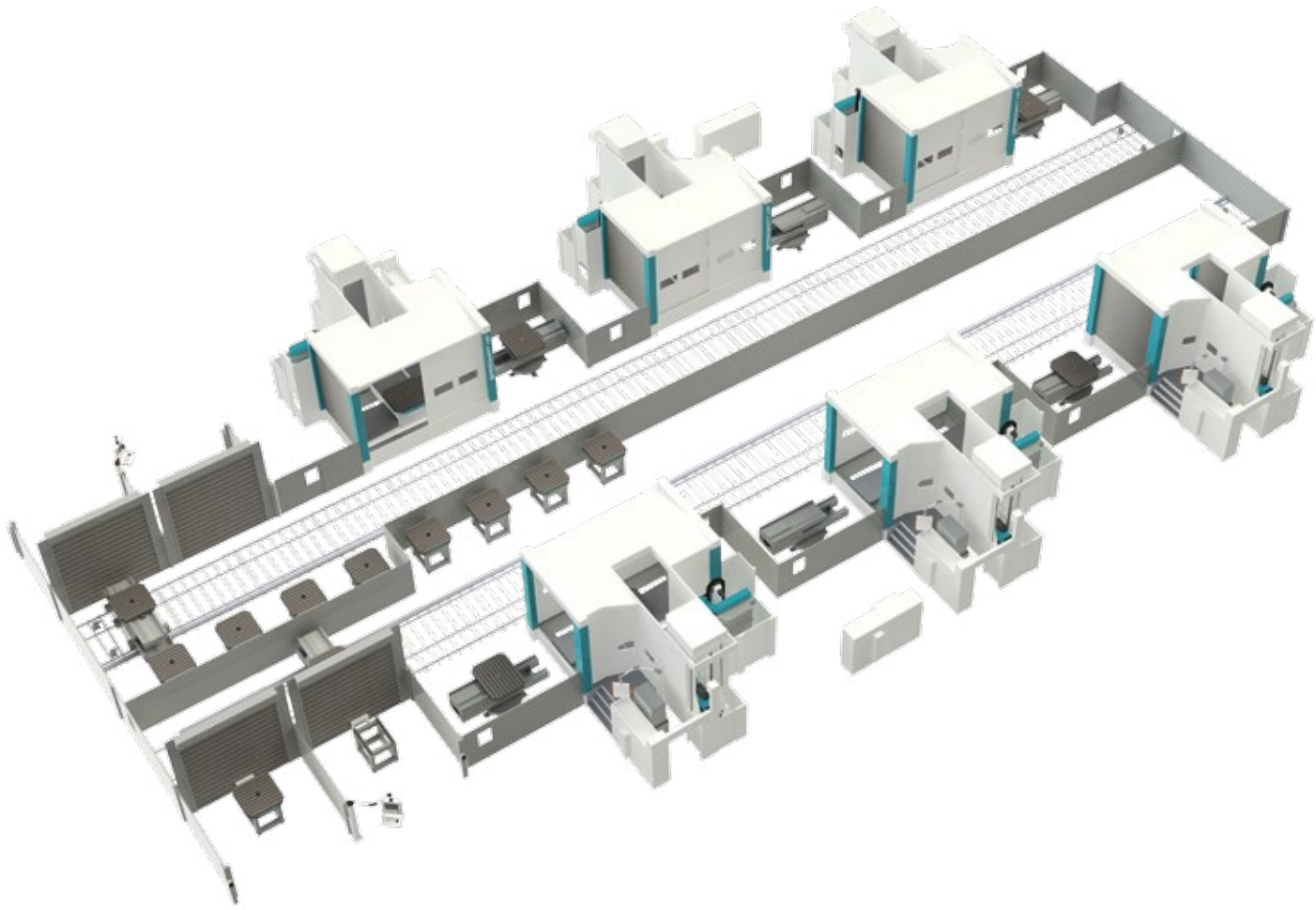
HSS (Hydrostatic Sliding Spindle):
precise stiffness and dampening control for better machining in difficult conditions: no metal on metal contact, no stick slip, less risk of bar surface damage, for higher positioning accuracy, less vibration and longer tool life,
unique PAMA innovative oil supply system:

- less flow required
- no supplementary hydraulic power pack and piping
- no supplementary chiller
- energy saving

vibration amplitude



the oils and engine coolant fluids used, which are linked to the reference ambient temperature by a sophisticated temperature regulating system, PAMA has also introduced the **ATC (Automatic Thermal Compensation)** system, based on a number patented solutions. The expansion and contraction of both the ram and boring spindle are compensated physically in real time viaa control systems, which measure the movements of these elements against reference bars using extremely precise linear transducers. The signals received from these transducers are processed with proprietary algorithms which filter out disturbance and transfer the corrections necessary to the machine control system. The **HSS** spindle is completely free of friction and stick-slip phenomena, further improving the already outstanding performance of the **ATC** system.



To ensure precision throughout the entire machine, additional improvements have also been implemented to increase the accuracy and dynamic response of the compensation systems. Speedram and Speedmill floor type machines with horizontal ram are equipped with the **HMC (Hydraulic Machine Compensation)** package, which performs different functions depending on the model, to compensate for both ram droop and the bending moment caused by the movement of the ram itself. In particular, on Speedram machines, have been introduced hydraulic compensation systems, using an innovative system which cancels out hysteresis caused by the friction of the gaskets: the result is perfectly precise ram extension compensation, even at high Z axis speeds.

Vertiram series machines, on the other hand, are equipped with the **HCC (Hydraulic Crossrail Compensation)** system, which compensates for deformation caused by bending and torsional moments generated by the head on the crossrail which alter the position of the head itself: an ingenious system of beams and hydraulic cylinders generate moments inducing opposing deformation effects to maintain the orthogonality of the axes which, as is universally known, cannot be corrected by software.

RELIABILITY AND PRODUCTIVITY

PAMA management has set quality as one of the primary goals for the company, bringing every aspect of the production process into play through the extensive implementation of lean methods, the systematic application of problem solving techniques and, for more complex cases, A3 methods. The substantial investments made by the company, through which PAMA now boasts state of the art machines in all of its departments, have not been however limited to strictly production related areas, but have also involved process control activities, with the acquisition of three Zeiss measurement machines and the installation of an approximately 1200 m^2 air conditioned area dedicated for measurements. In addition to this, the company has also completely air conditioned the spindle and accessory head machining departments. The result of these initiatives has been a significant increase in reliability, and PAMA products now offer customers the certainty of working in complete safety - a crucial factor when machining parts of considerable value.

As part of this commitment to continuously improving product reliability, PAMA has developed the **MSM (Machine Sensor Monitoring)** system, which uses temperature, pressure, torque and acceleration sensors to monitor the state of health of the machine and warn the user promptly in the event of any possible functional problems and, as a result, permit effective predictive maintenance.

Proper regular maintenance is also fundamental for superior reliability. This is why PAMA has developed the **PMP (Preventive Maintenance Program)**, a software suite that indicates when machine maintenance is necessary by notifying the operator and/or maintenance technician with messages, alarms and icons which are always displayed in the foreground on the CNC system monitor. Maintenance procedures must be confirmed after completion by entering a password, and are logged in a file. The user interface consists of video screens indicating the maintenance status of the entire machine, including tables and accessory heads. All systems have been optimised to facilitate machine maintenance as much as possible, with all components subject to periodic inspection situated in easily accessible locations for easy verification, even while the machine is operating. The majority of filters, pressure regulator valves and inspection points are situated in an energy box that is

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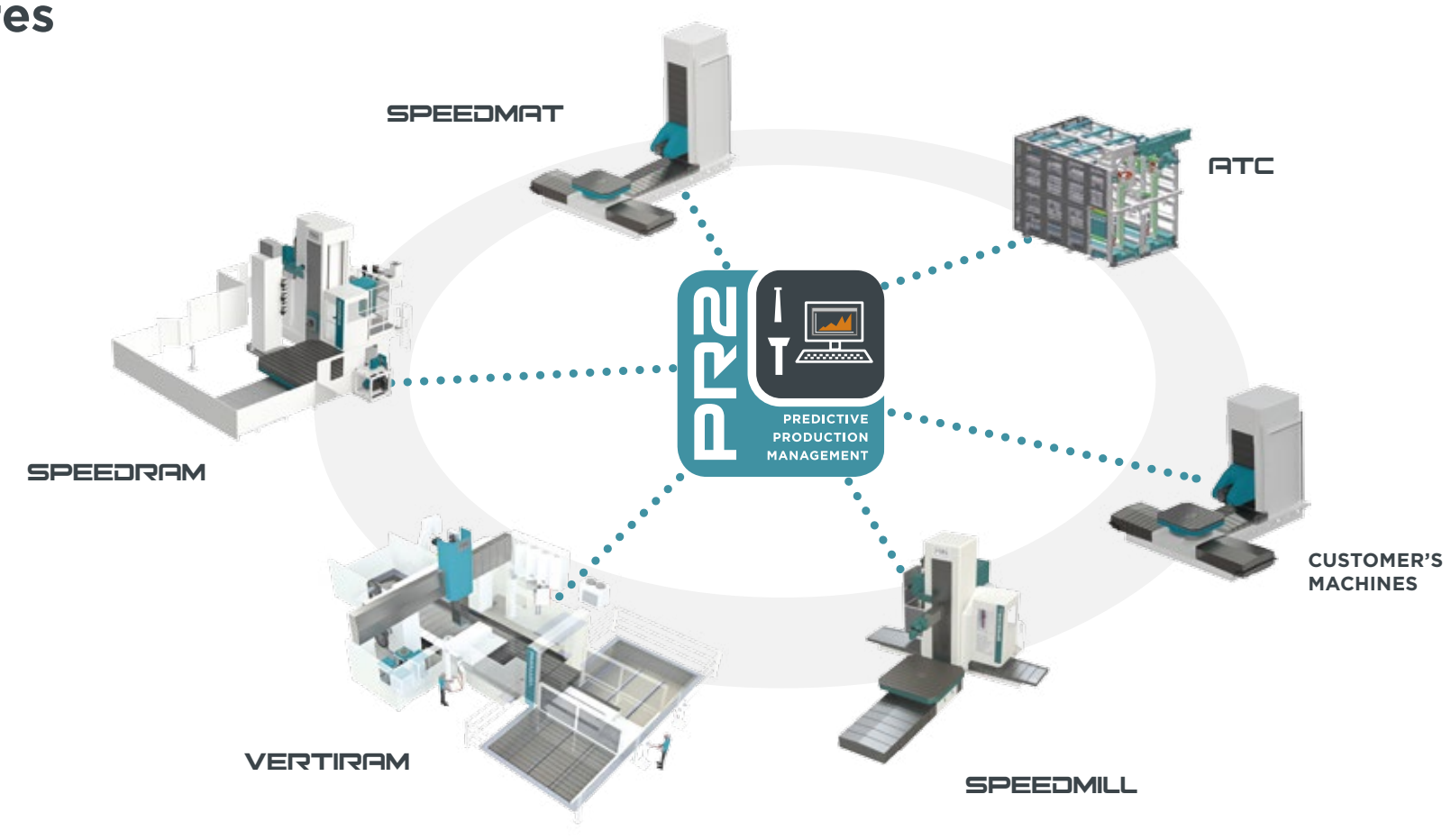
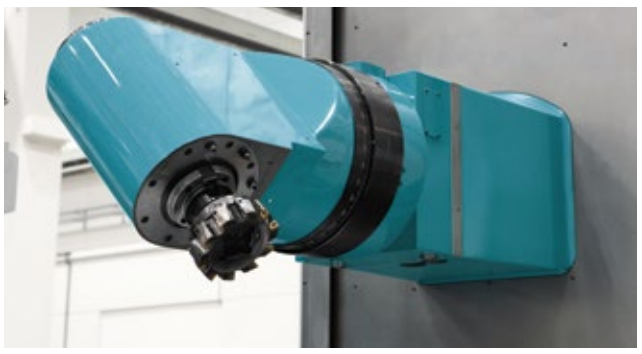
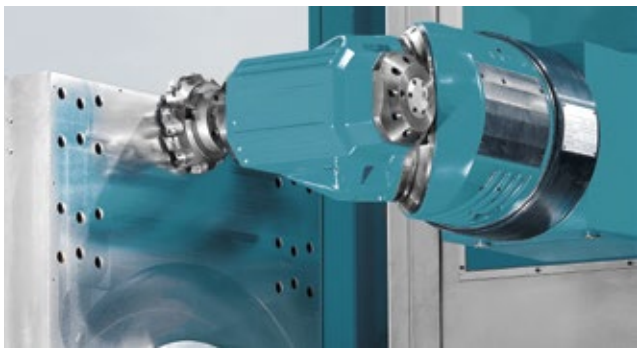
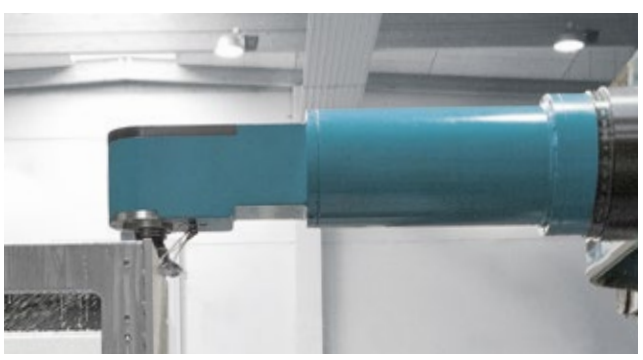








PR2 PREDICTIVE PRODUCTION MANAGEMENT

easily accessible from the machine platform.

The tried and tested **PR2 (Predictive Production Management)** software suite created to increase the efficiency and maximise the productivity of the production process has now evolved into the **PR2 Suite**, gaining enhanced modularity to allow the implementation of future functions and permit the rolling updates necessary as IT systems continue to evolve. **PR2 Suite** offers real time access to a huge quantity of reliable data, which may be used to re-arrange production ,optimise resources and offering usage forecasts for individual machines, cells or even the entire machine shop based on verification of the states of existing tools and identification of their physical allocation (ATC of specific machine or tool room). A comprehensive reporting function offers a vision of the effective efficiency of the machine or installation, identifying weaknesses where resource management could be improved. PR2 Suite is also an effective analytical tool to further improve preventive maintenance, through detailed, critical analysis of the machine downtime log.

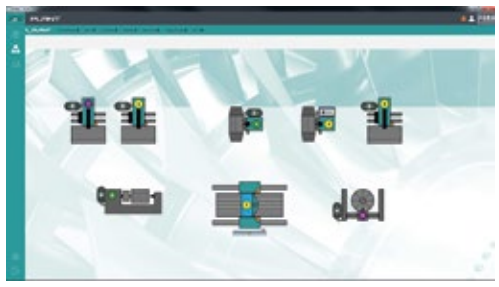
Last but not least are the accessory heads, manufactured entirely in-house by PAMA and the result of the company's many years of experience in resolving the most challenging technological problems. While already engineered for the highest possible reliability, precision and material removal capacity, PAMA accessory heads have now gained a suite of new functions and features to make them even more efficient than ever, as part of the **PGE (PAMA Global Efficiency)** programme.The **AHC (Automatic Head Calibration)** system now offered checks the geometry of accessory heads automatically by taking a series of probe measurements on a reference sphere and comparing these values against measurements stored previously, for reliable geometry verification. **CSH (Clever Sensored Heads)** are now available to complement **MSM** and **PMP** systems.

CSH CLEVER SENSORED HEADS

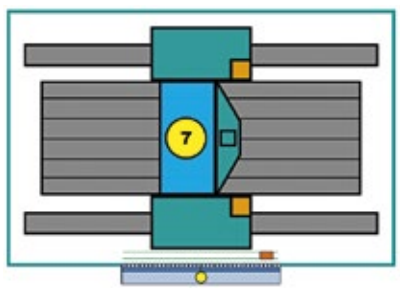
These heads are equipped with temperature, acceleration and speed sensors to allow continuous monitoring of the state of health of the accessory head. As well as ensuring the correct operating conditions, these sensors also permit effective predictive maintenance.

AHC AUTOMATIC HEAD COMPENSATION

complete reporting of production unit activities



efficient managing of complex units (even with compatible customer's machines)



efficient managing of single production unit

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direct spindle drive

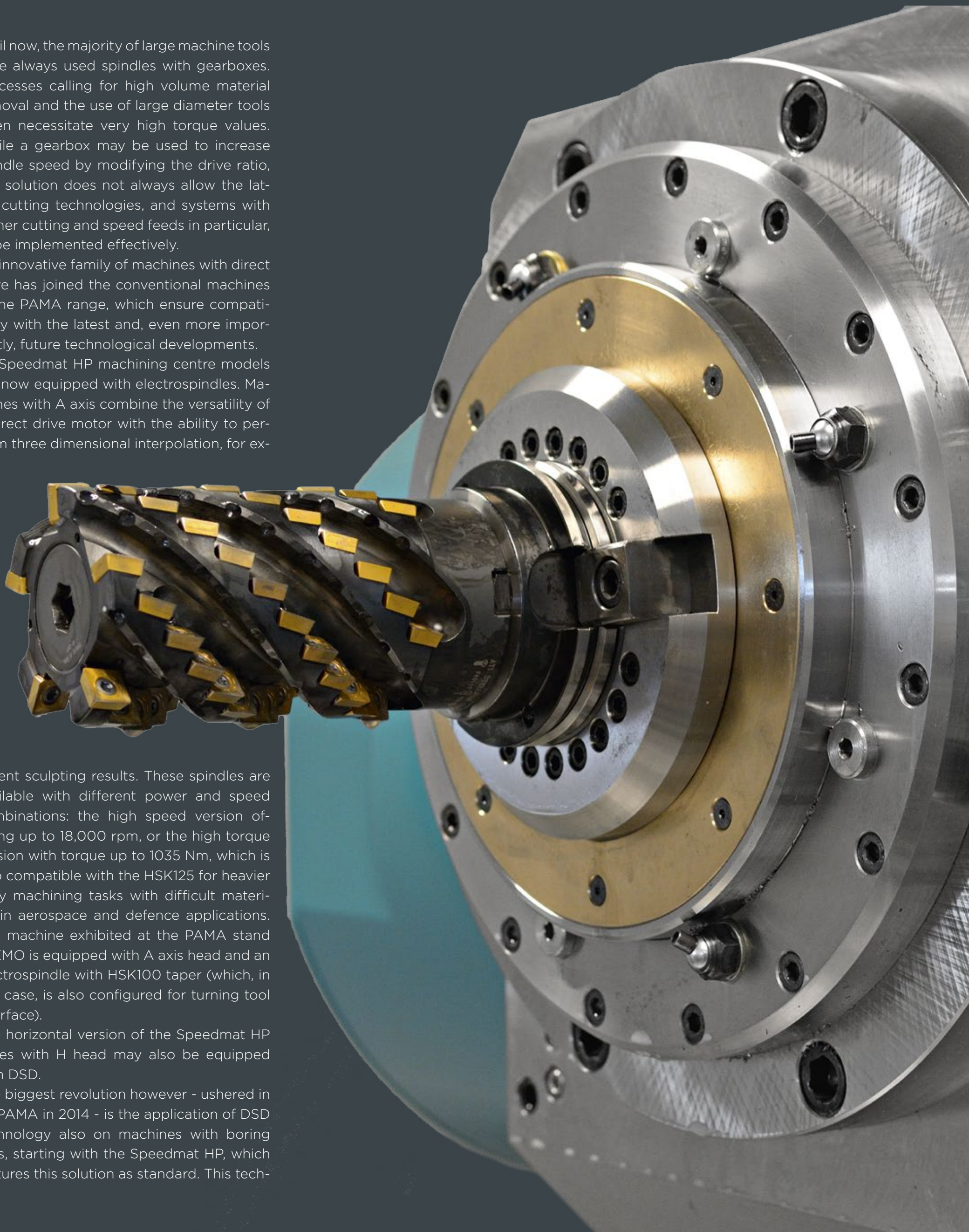
Until now, the majority of large machine tools have always used spindles with gearboxes. Processes calling for high volume material removal and the use of large diameter tools often necessitate very high torque values. While a gearbox may be used to increase spindle speed by modifying the drive ratio, this solution does not always allow the latest cutting technologies, and systems with higher cutting and speed feeds in particular, to be implemented effectively.

An innovative family of machines with direct drive has joined the conventional machines in the PAMA range, which ensure compatibility with the latest and, even more importantly, future technological developments.

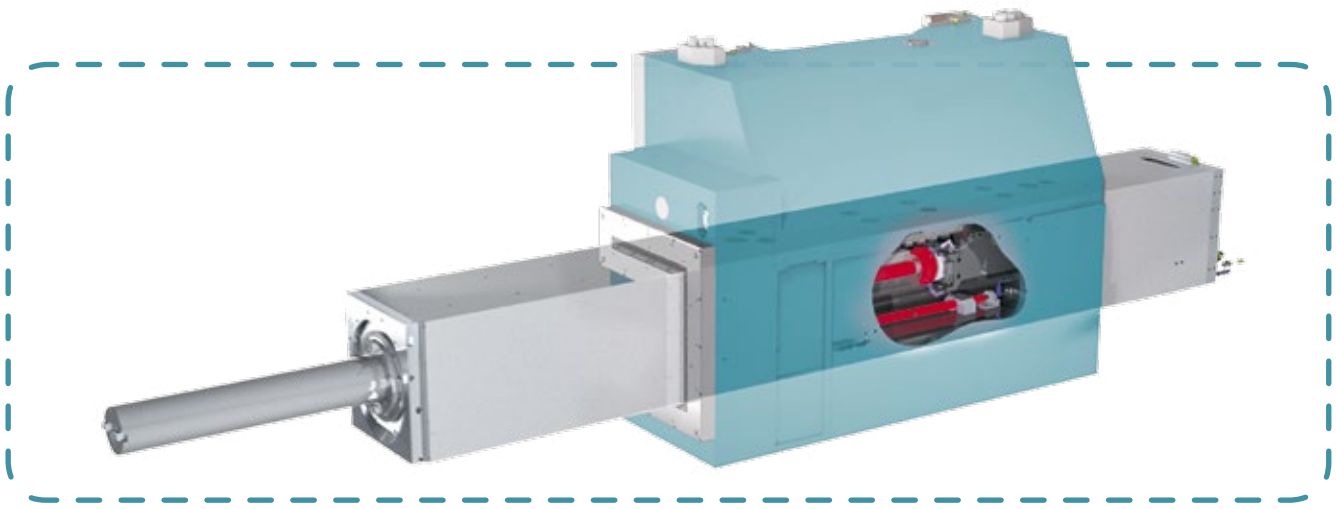
All Speedmat HP machining centre models are now equipped with electrospindles. Machines with A axis combine the versatility of a direct drive motor with the ability to perform three dimensional interpolation, for excellent sculpting results. These spindles are available with different power and speed combinations: the high speed version offering up to 18,000 rpm, or the high torque version with torque up to 1035 Nm, which is also compatible with the HSK125 for heavier duty machining tasks with difficult materials in aerospace and defence applications. The machine exhibited at the PAMA stand at EMO is equipped with A axis head and an electrospindle with HSK100 taper (which, in this case, is also configured for turning tool interface).

The horizontal version of the Speedmat HP series with H head may also be equipped with DSD.

The biggest revolution however - ushered in by PAMA in 2014 - is the application of DSD technology also on machines with boring bars, starting with the Speedmat HP, which features this solution as standard. This tech-



1ST WORLDWIDE IN BORING



Direct spindle drive™
increased spindle stiffness and dynamic performances
rigid tapping without heavy limitation increased tool life

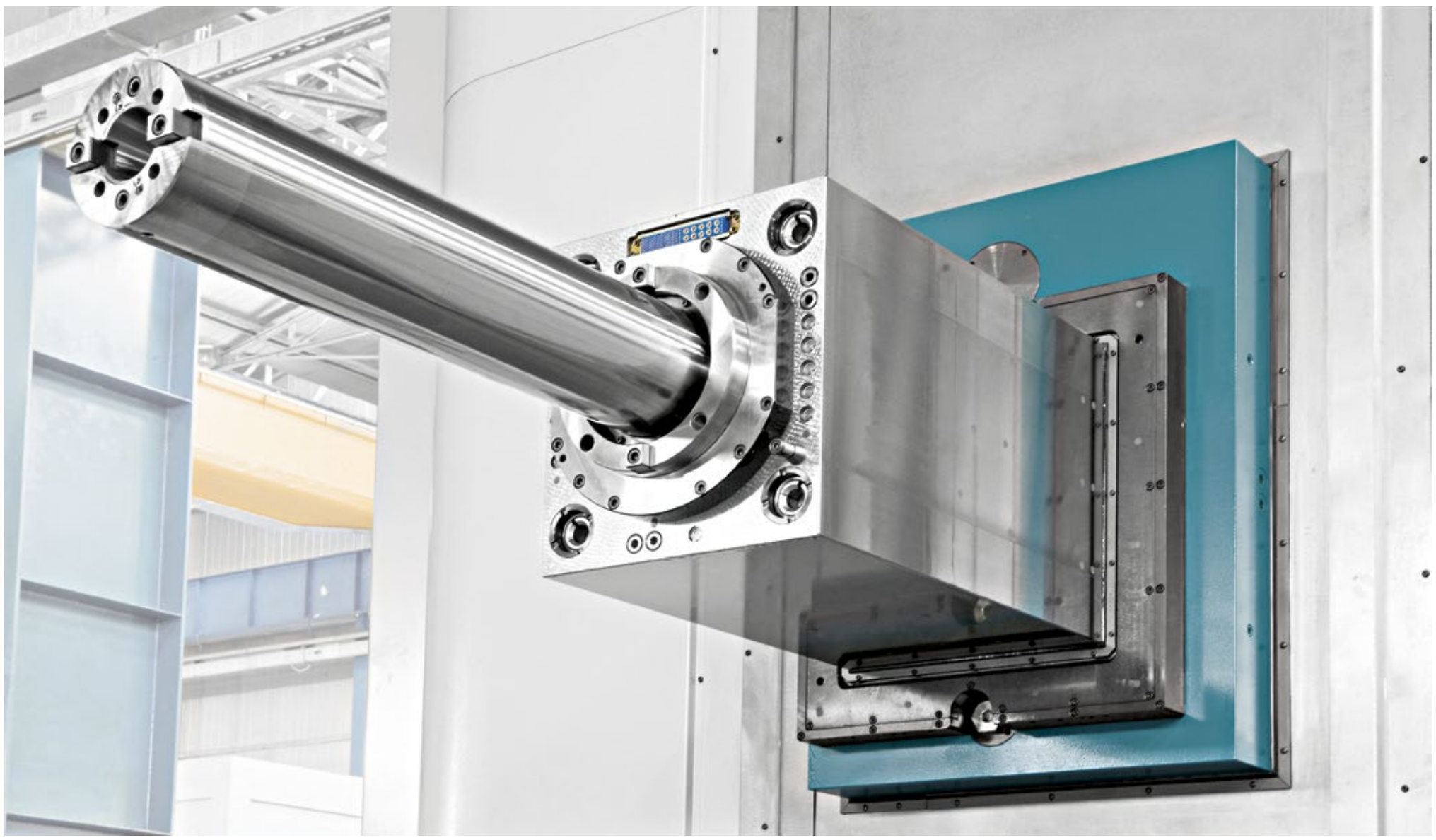
Higher reliability: mechanical components reduced by 30%,
simpler auxilary devices (hydraulics and electrics)

Hybrid spindle bearings with variable preload: increased
spindle speed, increased stiffness at low speed

DSD (Direct Spindle Drive): no gearbox

nology offers exactly the same torque at the head as a gearbox system, but with higher speeds and acceleration, making it better suited for high speed machining processes. DSD is also implemented in the Speedram HP range of floor type boring machines. The main difference between the related models in the Speedram range lies in the head itself. The research and development efforts poured into this project have been amply rewarded by the extraordinary performance of the new heads. A Speedram 2000 HP machine produces torque value comparable to those of a Speedram 2000 with two speed gearbox, but with significant advantages in terms of speed (rpm), the weight of the head, spindle acceleration and reduced vibration. Especially when used in conjunction with a hydrostatically supported boring bar (HSS), direct drive technology represents the best solution available today to reduce vibration, even at considerable boring bar extensions, and with procedures involving uninterrupted cuts in particular. Where interrupted cuts are unavoidable, direct drive ensures significantly better surface finish quality and tool durability. If the user intends to use the machine for performing large numbers of holes, and small diameter and tapped holes in particular, these advantages also make it

EXCLUSIVE DIRECT DRIVE TECHNOLOGY

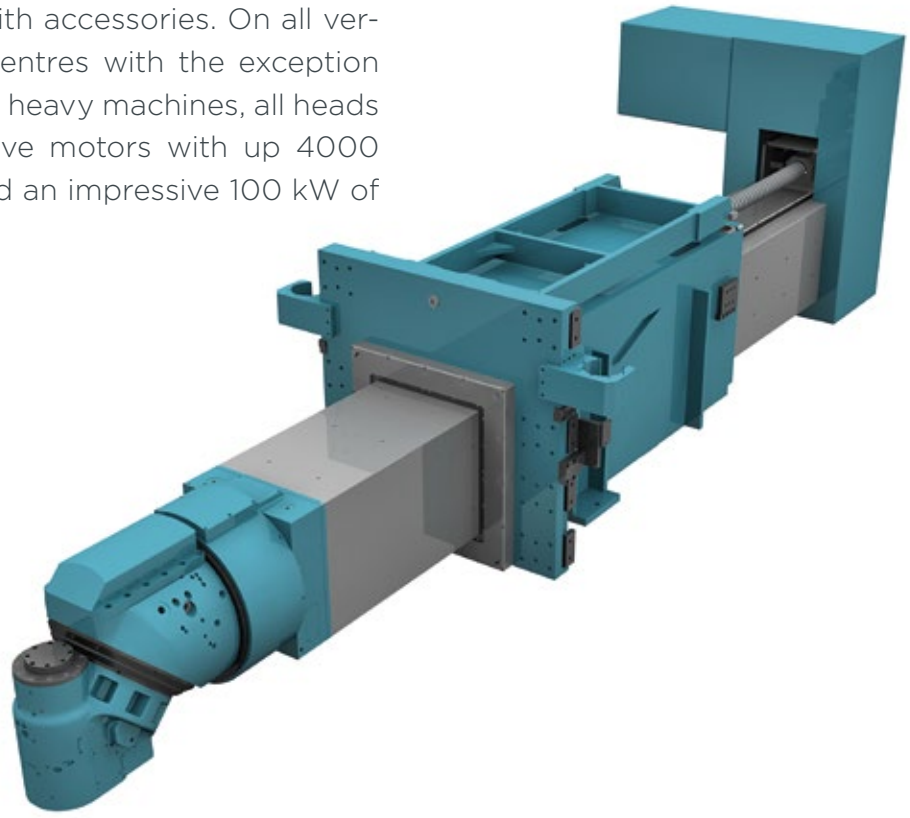


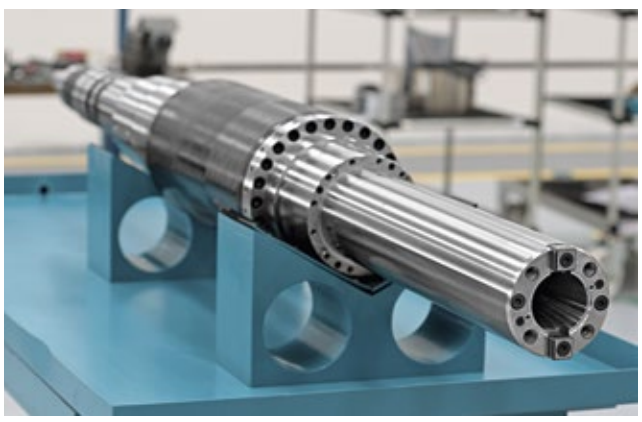
direct spindle drive

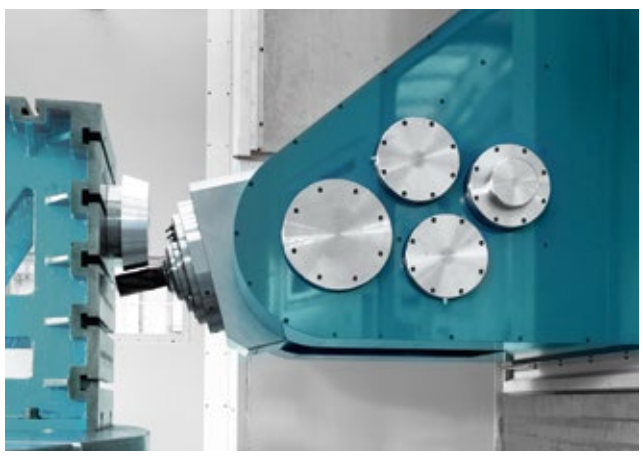
possible to work with smaller diameter bits and significantly reduce machining times; due to the lower inertia of the spindle, inversion times for rigid tapping processes and the time needed to attain the required spindle speed are much shorter than with a geared drive system.
Otherwise, these machines share all the same characteristics that set PAMA boring machines as the industry benchmark: precision is guaranteed by a head manufacturing process conducted entirely in-house (including machining processes) and by the ATC (Automatic Thermal Compensation) and HMC (Hydraulic Machine Compensation) systems, which keep the tool in the correct spatial position and at the correct angle at all times, to ensure the extreme precision necessary for high speed machining, even when working with very large surface areas and in variable environmental conditions.
DSD technology has of course also been extended to PAMA machines with no boring bar for use with accessories. On all vertical machining centres with the exception of Vertiram 4000 heavy machines, all heads feature direct drive motors with up 4000 Nm of torque, and an impressive 100 kW of

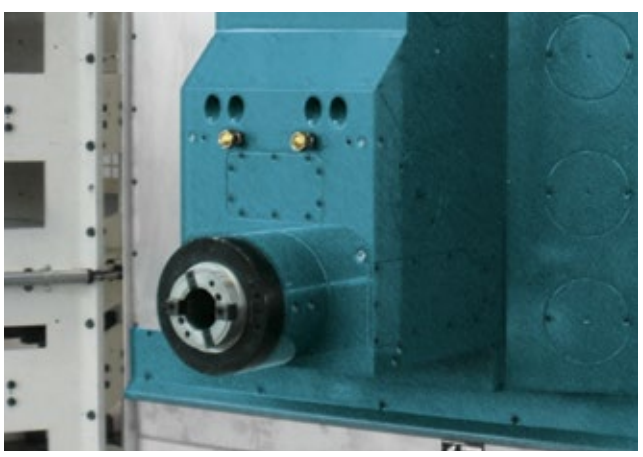
ATC (Automatic Thermal Compensation): real time CNC controlled exclusive compensation of ram and spindle elongation / contraction by direct measurement (PAMA patents)

HSS (Hydrostatic Sliding Spindle): boring spindle sliding on hydrostatic bearings







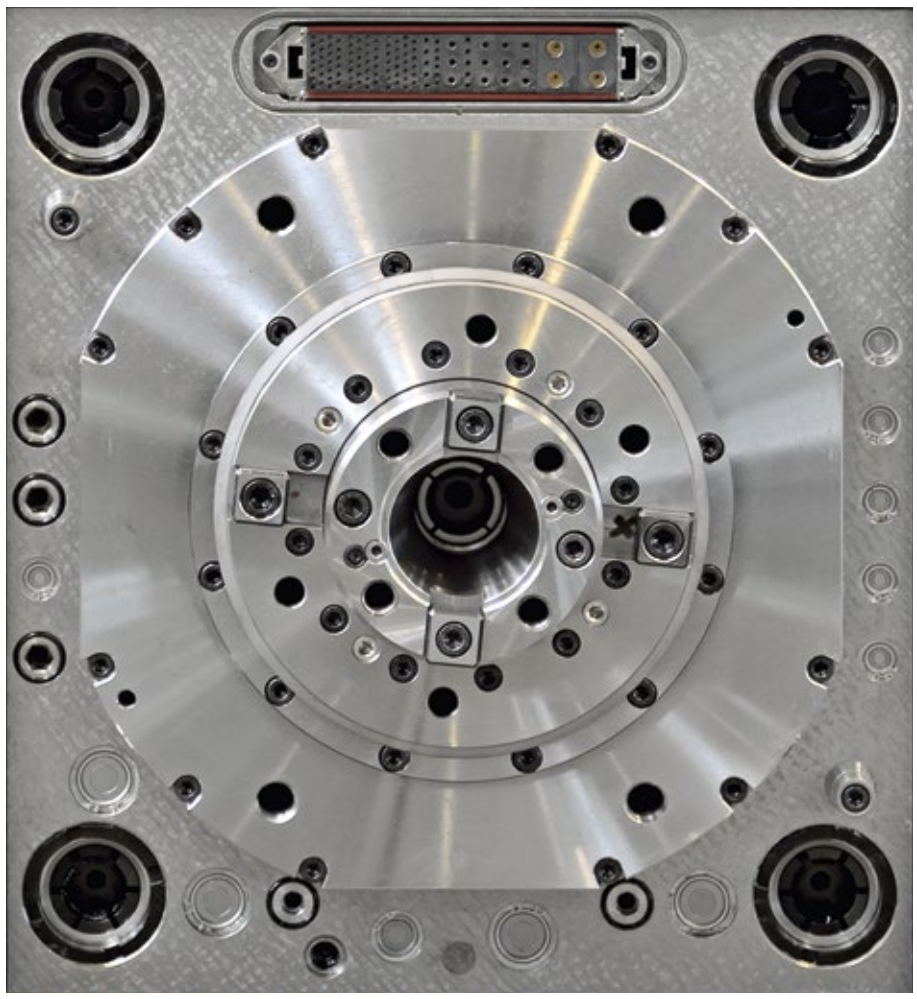


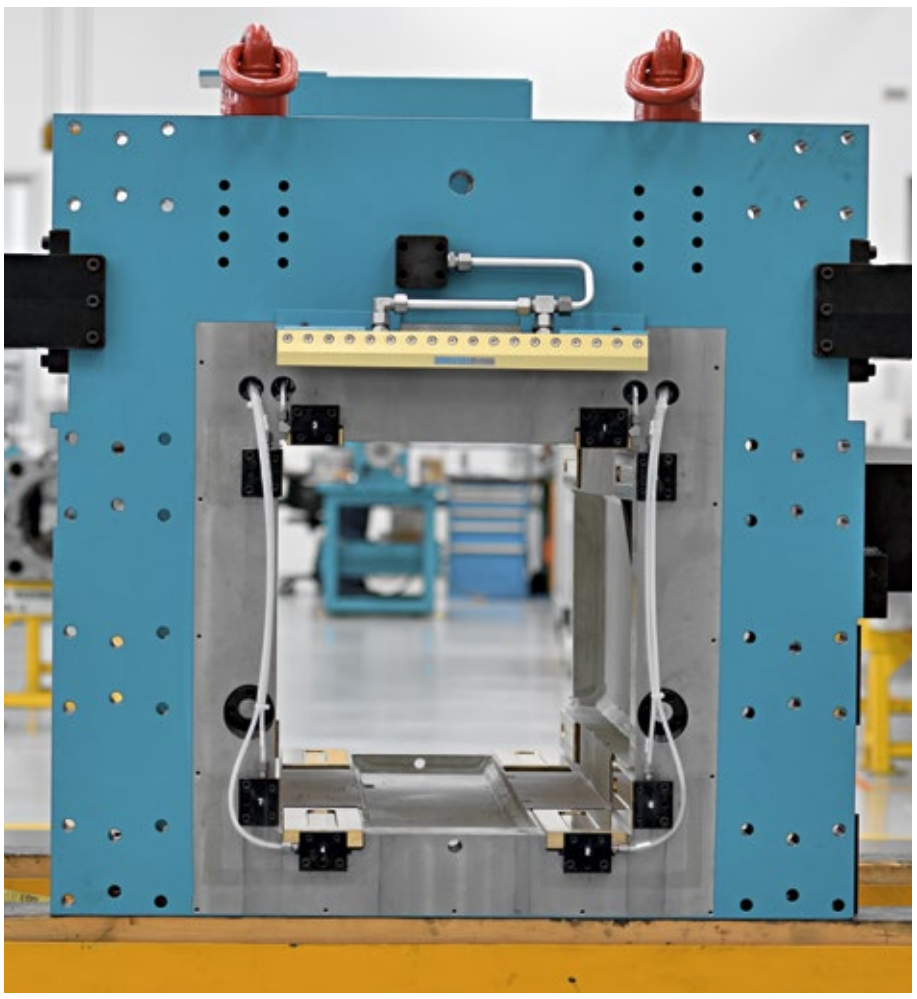
power in S1. These heads are capable of material removal rates up to 2 litres per minute, even when working with 45 HRC steel for moulds, yet still offer the advantage of extremely high surface quality when preparing a piece for finishing. These characteristics, combined with the choice of accessory heads available for Vertiram machines, sets this series apart as the undisputed industry benchmark in both gantry and moving table configurations.

The new PAMA Speedmill range is an equally interesting proposition. With 73 kW available in S1 and a main head speed of 8000 rpm, combined with impressive axis acceleration and speed, the Speedmill sets the benchmark for floor type milling machines.

In addition to unparalleled performance, DSD technology also offers superior reliability and energy efficiency. With drastically fewer components and extreme accessibility for maintenance, combined with the extraordinary efficiency of the drivetrain, heads featuring this technology are more durable and offer lower energy costs for the same production volumes.

HMC (Hydraulic Machine Compensation): real time CNC controlled compensation of ram deflection, headstock tilting, column deflection and base rotation





multitasking on a large scale

For over 80 years PAMA has made its name known on the international market in a wide variety of application fields with different technological solutions: from the large horizontal floor type machines and machining centres to the vertical gantry machines. Even in large parts manufacturing, the latest market evolutions have raised the bar in plant productivity, including process efficiency and the stability and certainty of precision in production.

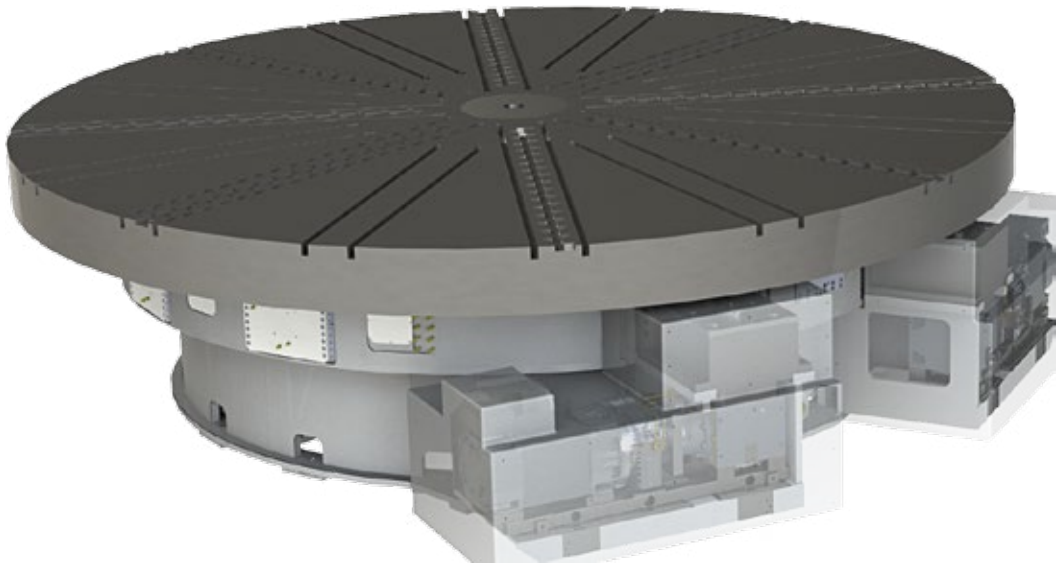
The solutions that PAMA has introduced over the years to meet these demands are specifically aimed at combining several processes on the same machine resulting in a drastic reduction of the number of set-up and centering operations during the different steps of the manufacturing process. This can also drastically reduce unexpected events and errors arising from mishandling and human errors.

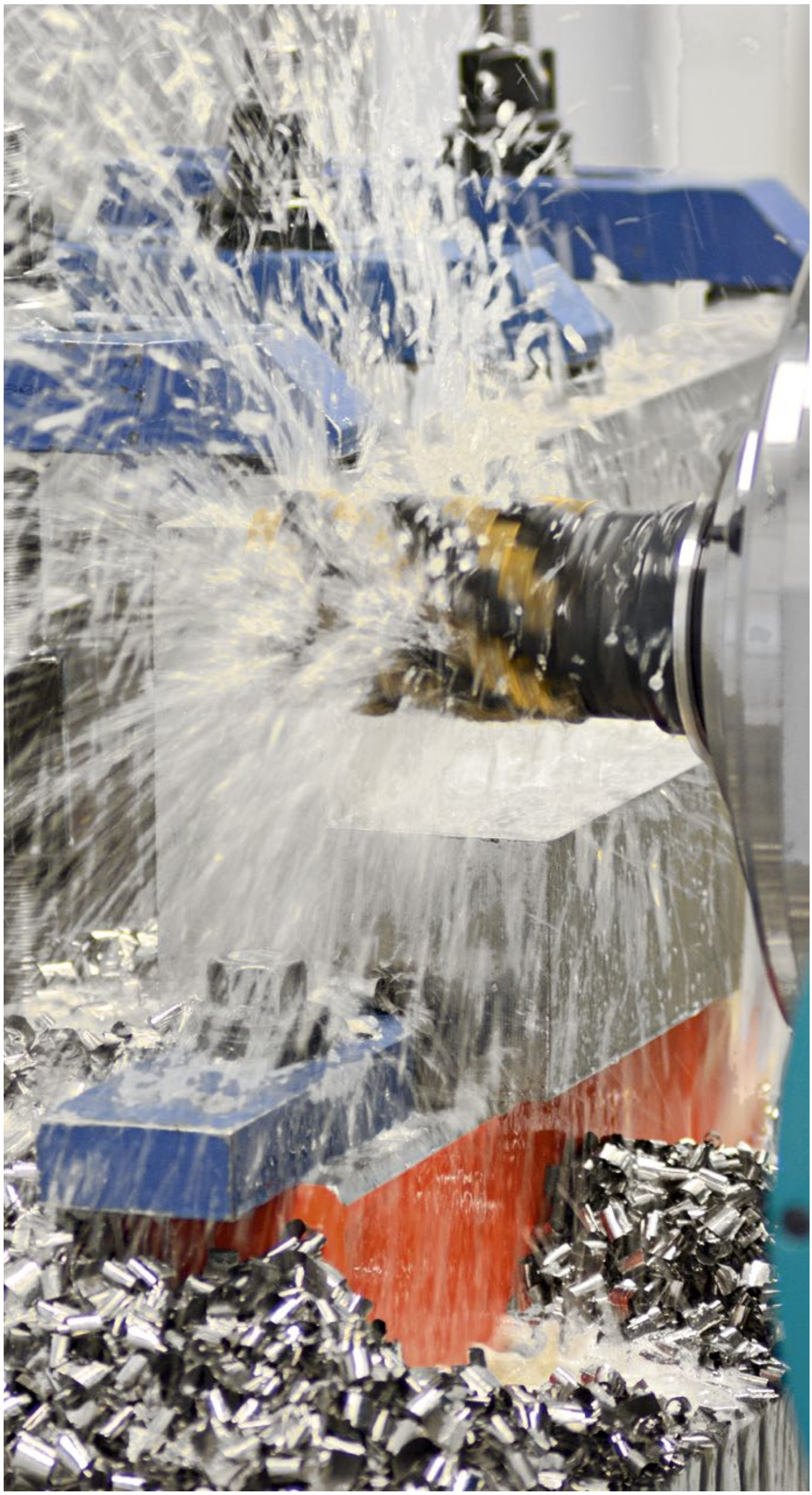
On all the machines in its line, PAMA has the capability of performing multiple operations automatically.

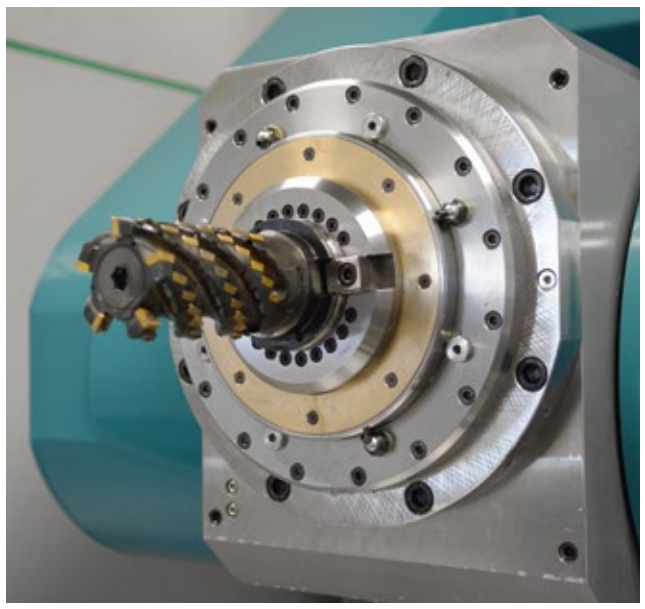
The first and foremost is being able to integrate milling and turning operations. PAMA has developed two different solutions based on the mass of the part to be processed.

The line of TRT tables for parts up to 35 tons takes advantage of the exclusive THT (Turning Hybrid Table) patented technology. The dilemma of those who have to face an investment in a machine that can both mill and turn is often related to the milling requirements. To rotate at the high speed needed for turning, tables make use of roller bearings which when running the table as 'B' axis and especially in roughing operations cannot provide good rigidity and stiffness. The advantages of using roller bearing and hydrostatic bearing were combined in a table that yields the best performance for both turning and milling operations. Rotating speed up to 250 rpm is achieved thanks to a dual drive system which also ensures maximum precision when milling and interpolating thanks to the exclusive and patented PAMA technology.

The use of this new technology has brought the turning performances of PAMA machining centres—both the horizontal Speedmat HP and the vertical Vertiram—up to par with the best lathes, without trading off their renowned milling capabilities, either in boring







or in high dynamic 5-axis machining tasks, making multitasking processes on the same machine a true advantage for the customer. When in milling configuration, the TRT tables provide an axial stiffness and a tilting moment which are more than double compared to the hybrid tables currently on the market. In any machining sector field you gain considerable process efficiency when you can machine the part in a single set up and at the same time improving the quality of the product thanks to the reduced handling.

To fully utilize the table's potential, especially on the horizontal machining centres PAMA has designed head attachments specific for turning with specific solutions for either ID and OD turning.

A clearly limiting factor on a horizontal machining centre is not being able to use turning tools with good stiffness. The Speedmat HP machining centres offer different options. The simplest and most common is mounting the turning tools directly in the spindle of the 'A' tilting headstock, which comes with a system to eliminate side load to the bearing. Tool length in this case is limited, but it is the most versatile solution for OD Turning or ID turning not excessively deep. With tool length requirement ex-

THT (Turning Hybrid Table):
combined technology of rolling and hydrostatic bearings for best turning and milling

DOT (Dynamic Optimized Tuning): optimized automatic adjustment of table control parameters according to work piece inertia

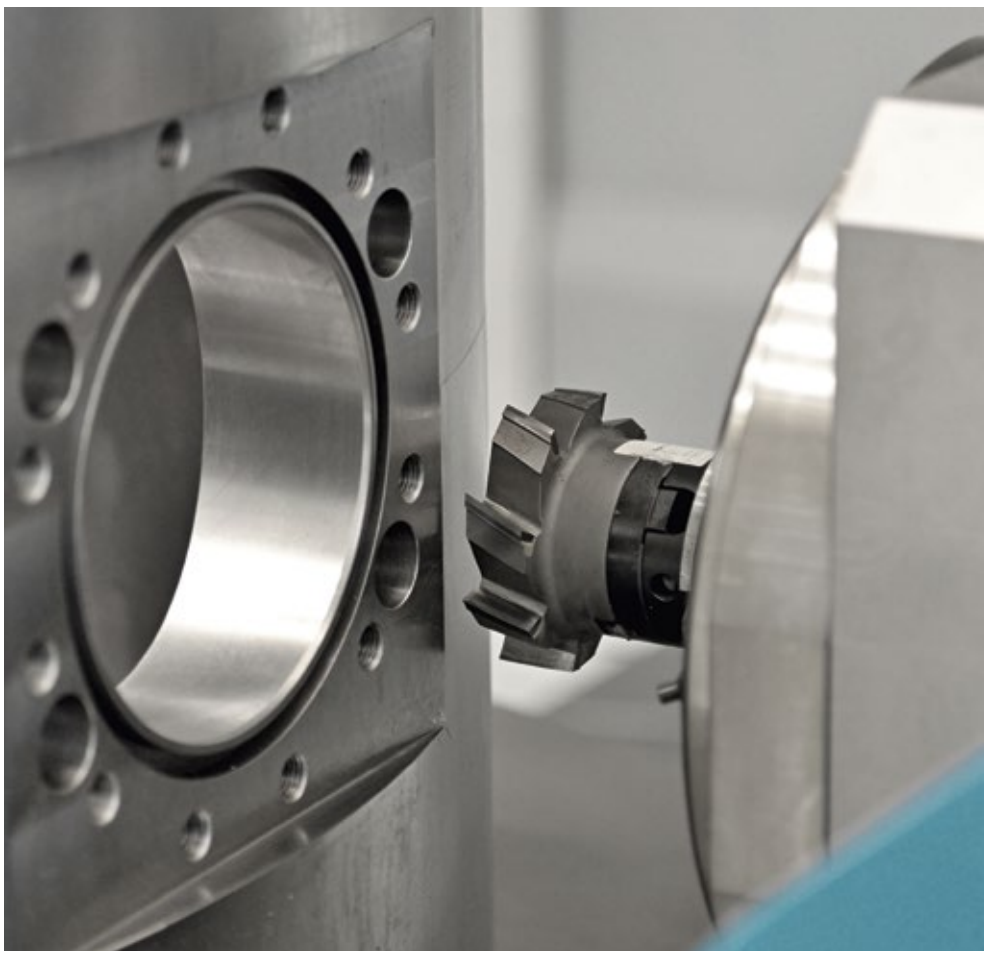
multitasking on a large scale

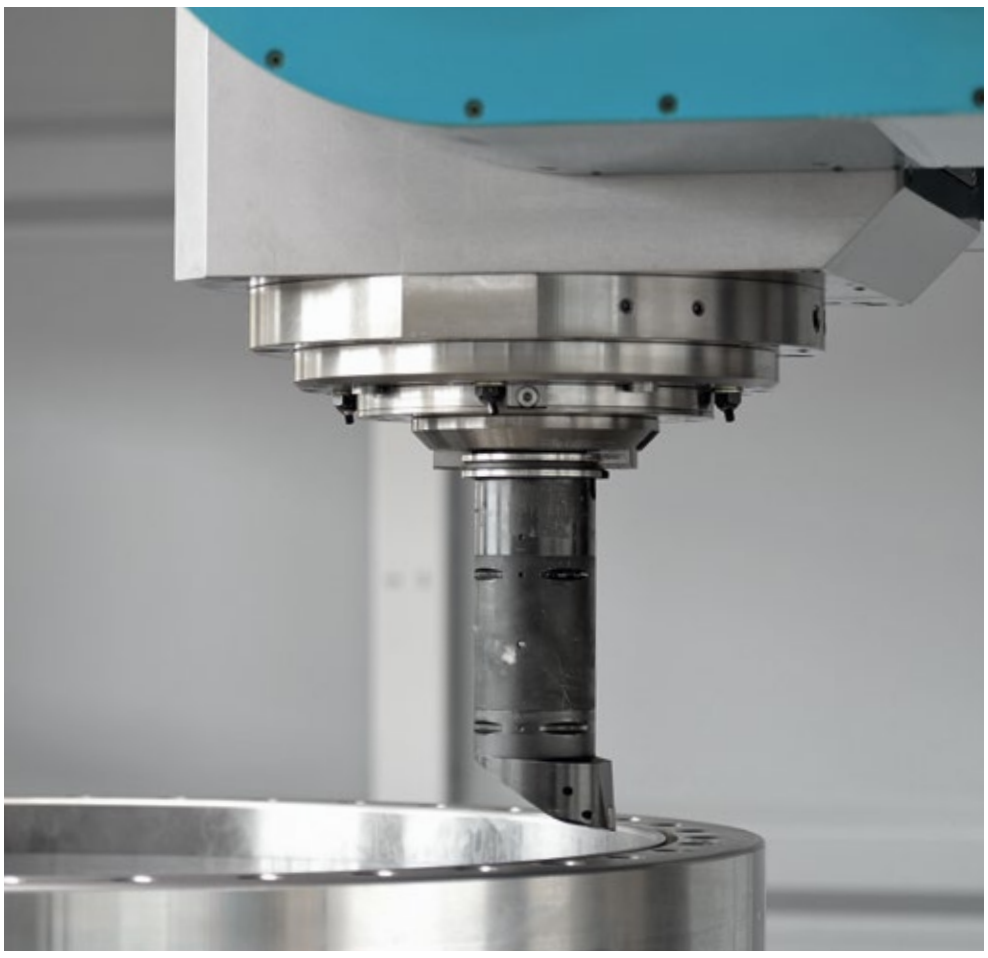
ceeding 400-500mm, PAMA provides an alternative solution using a head attachment specific for turning that can be automatically exchanged on ‘A’ tilting as well as on ‘WD’ boring spindle headstock styles. Tool change on these heads is also automatic and CAPTO style tool holders can be used for the turning tools.

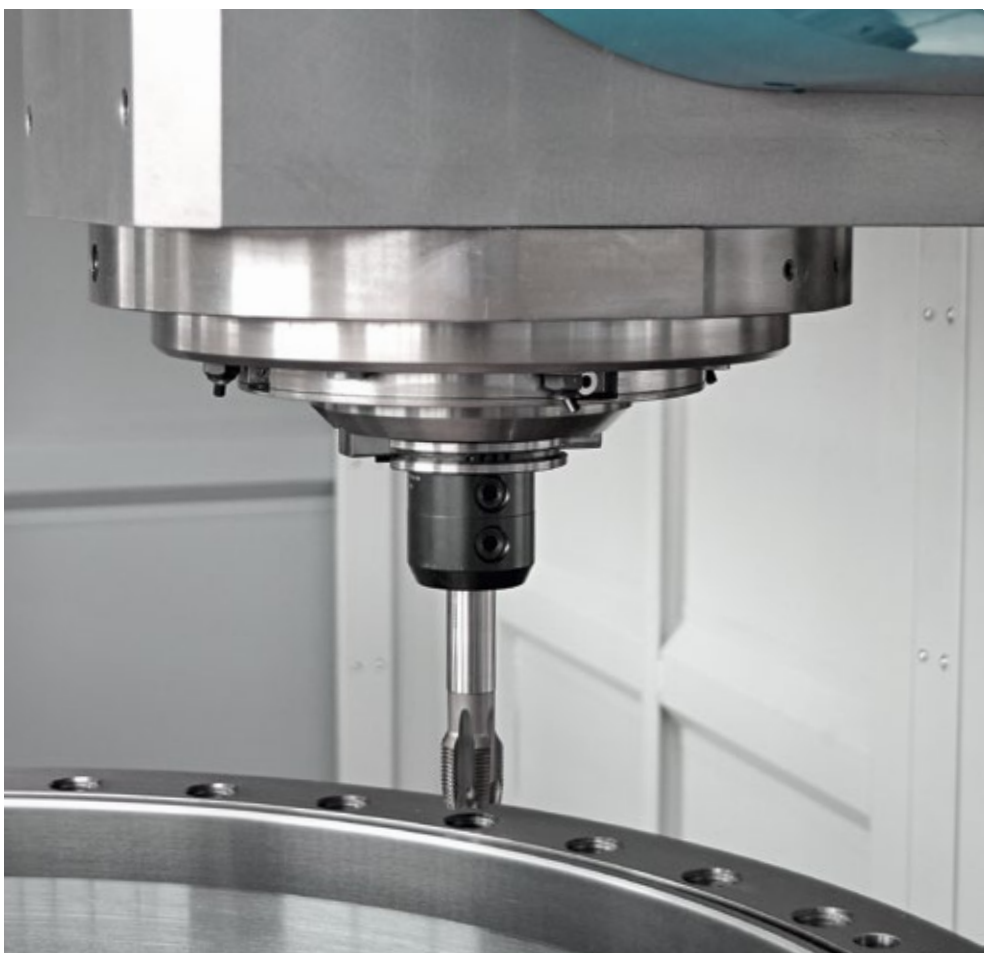
One of the machines that PAMA displays at EMO is the Speedmat HP2T: a multitasking machining centre which, together with the Speedmat HP1, makes up the latest addition to an already highly successful line of machines. With hundreds of installations worldwide PAMA is particularly proud of its Speedmat HP remarkable accomplishment, as the company has only recently ventured into the machining centre sector. This machine introduces a freshly patented solution: the turning function allows heavy duty machining operations even on hard materials at speeds up to 250 rpm, but is also conceived and built to function just as effectively as a dedicated ‘B’ table for milling operations. PAMA application engineers can develop tailor-made processes for each client, introducing more comprehensive options based on needs to complete the process. Whether the client wants to use turning tools directly on the spindle or mounted on dedicated turning head attachments, PAMA defines the most effective and efficient process for every possible situation.

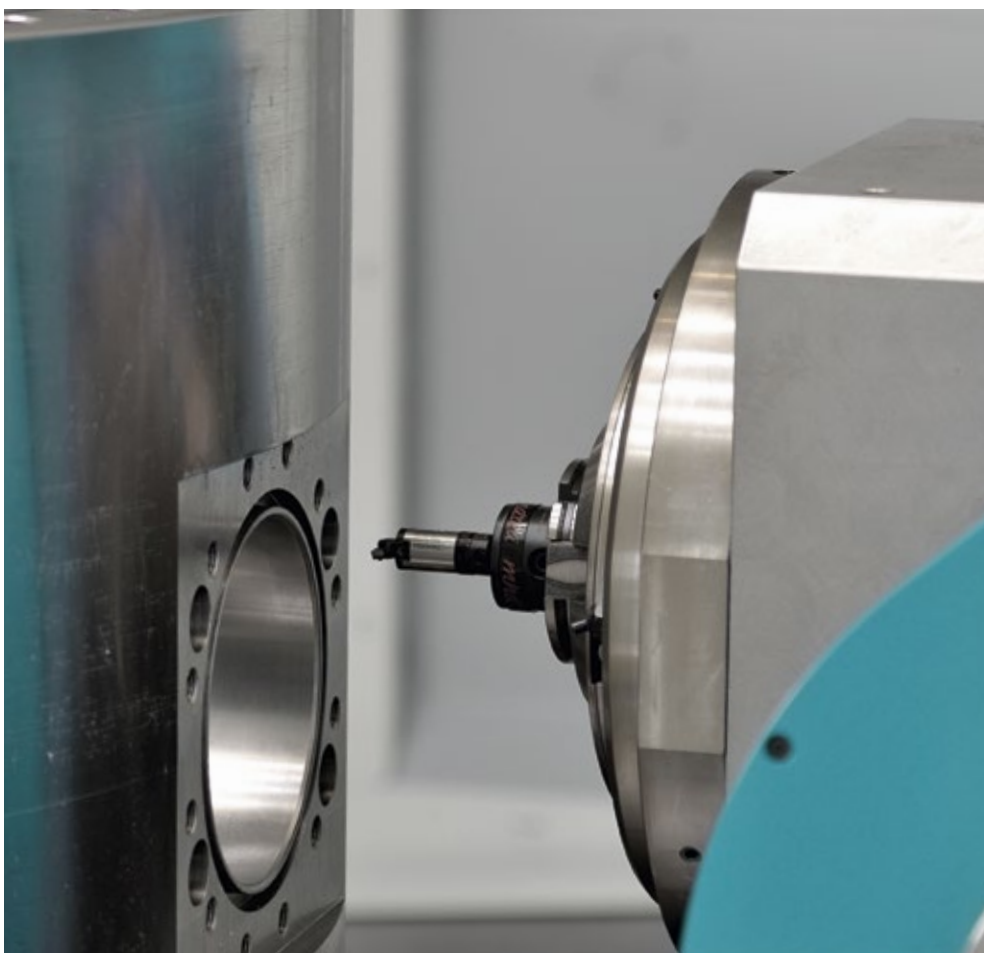
Speedmat HP may be provided with different headstock configurations, giving each a specific focus based on the field of application. First and foremost, it is available with a ‘WD’ headstock with 110 to 160-mm diameter boring spindle with direct drive technology and more than 2000Nm of torque to meet the demands of those who need high removal rates. It can also be equipped, like the machine exhibited at EMO with an ‘A’ tilting head for 5-axis interpolation and electrospindle with torque over 1000Nm and HSK100 or HSK125 tool taper in heavy duty configuration for the aerospace industry or it can be provided with ‘H’ – Horizontal or ‘HV’– Horizontal Vertical and ‘HV-a’ interpolating head for five sides machining applications.

Automatic head change capability is available on all Speedmat models equipped with ‘WD’ or ‘A’ headstock style. Beside turning and facing, PAMA can provide also a variety of head attachments (with over 130









in its portfolio and the capability of manufacturing custom ones for the most complex applications) allowing to completely machine a part. This is a key characteristic for cutting setup time and for maintaining precision.

The Speedmat HP machining centre also offers a wide choice of options in terms of automation and different types of tool magazines, available with up to 770 tool spaces. Management of chips and tool coolant is also quite important. The Speedmat HP range is a self-contained fully enclosed structure entirely isolated from the foundations that allows for optimal management of chips evacuation and the use of high-pressure systems for thru the tool coolant and up to 200 L per minute low pressure flushing and washing systems.

Being able to work ‘lights out’ is also an essential quality of the Speedmat HP—either in a standalone version, with pallet changer up to 4 positions or with a pallet pool up to 8 positions, or with a shuttle system in a multiple machine cell. The number of manufacturing cells that PAMA already supplied is proof of what the Speedmat HP can do for its users, guaranteeing a particularly quick ROI.

PAMA turning solutions include more than

multitasking on a large scale

horizontal spindle machines: for all situations where a vertical machining process is preferable, either because of the morphology of the piece and the specific machining processes required, or to cater to the requisites and preferences of the customer, the VERTIRAM series of gantry machines offers a solution which is just as ideal. Today the Vertiram line is expanding with a line of machines either in portal or moving table with fixed or movable crossrail configuration tailored to meet the most exacting customer needs.
The largest models area characterized by use of integral hydrostatic ways on all axis, whereas on the smaller sizes models are available with large roller bearings on linear axis.
In the moving table configuration, X axis linear movement can be either on linear guideways for parts with net load up to 35t or on integral hydrostatic ways for net loads in excess of 35t. Both versions can be supplied with automatic pallet changer system.
All Vertiram models can be supplied with fixed or movable counterbalanced Crossrail. The ram is common on all models but it can house different transmission systems: direct drive for high speed applications or geared version for high torque applications. Both styles have automatic head attachment capabilities as well as automatic tool change capability on the heads with tool magazine options with capacity up to 700 tools. A number of different head attachments is available allowing for both milling and turning operations.

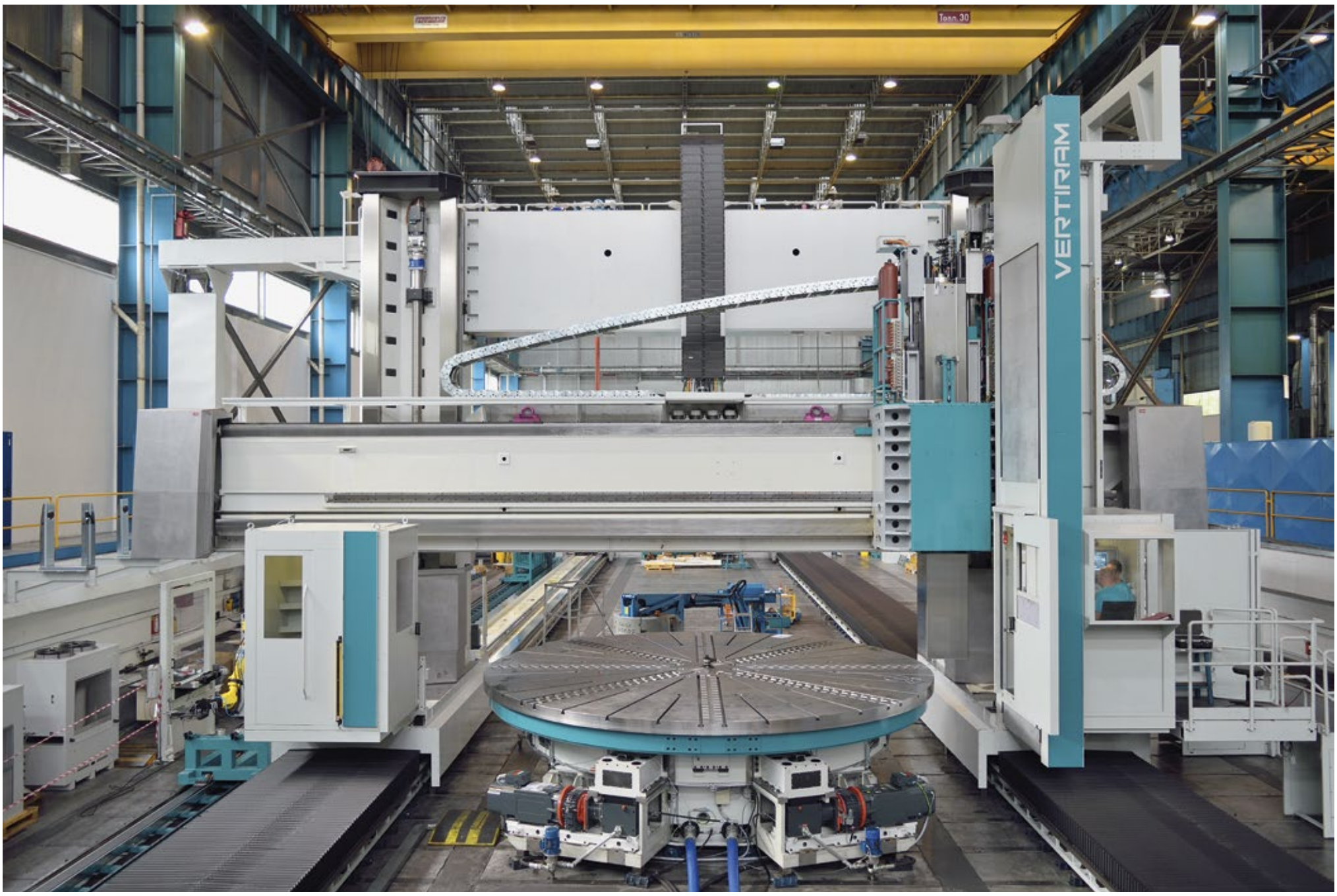
Vertiram precision is enhanced by PAMA patented solutions for thermal and geometrical deformations compensation.
Turning capability is available on all Vertiram models, with the addition of a PAMA TRT turning table starting at 2000mm dia and 250rpm, table also shared with the Speedmat HP. For larger table size and load capacity PAMA offers its TTH line of turning tables reaching 10000mm turning dia and up to 240kW of power. The TTH turning table can rotate up to 45rpm and is a fully hydrostatic table
The broad range of milling and turning head attachments, designed and built entirely by PAMA, can provide the end user with remarkable added value. By appropriately selecting amongst the wide range of heads, all the features on a part can be reached even in full 5 axis contouring, making application on a Vertiram particularly convenient in the precise processing of complex components.
PAMA is a solution provider. The value of the supply isn't just in the machine, but rather the system, which includes the production concept, the processing technology, equipment, tools and last but not least, the production management software and tools that let you always keep all of the production plans under control and do

Here are the turning tables available on PAMA machines:

TABLE		TRT 3	TRT 6	TRT 10	TRT 15	TRT 30
Table diameter	mm	1250	1600	2000	2500	3200
Max loading capacity	t*	3	6	10	15	30
Turning power	kW	40	51	51	51	60/90
Max turning speed	rpm	320	250	200	160	120
Max turning torque	Nm	4000	10000	13000	16000	32000 / 62500

TABLE		TTH 60	TTH 100	TTH 150	TTH 200	TTH 300
Table diameter	mm	4000	5000-6000	5000-6000	8000	8000
Max loading capacity	t*	60	100	150	200	300
Turning power	kW	90/110	140/186	140 / 186	186-238	186-238
Max turning speed	rpm	100	75/55	75/55	45	45
Max turning torque	Nm	90000 / 126500	184000 / 300000	225000 / 300000	400000 / 500000	400000 / 500000

* t in metric ton



HEIDENHAIN

+ Detailed 3-D Simulation Graphics

TNC controls from HEIDENHAIN have long featured practical functions for the production of single parts and series. The new 3-D simulation graphics of the TNC 640 are particularly helpful: They precisely display the workpiece and provide a significant preview of the actual machining process when milling or turning. Several new view options expose a precise and freely definable view of details. In this way, the TNC helps with the reliable recognition of faulty information or problematic machining processes prior to workpiece machining.

HEIDENHAIN ITALIANA S.r.l. 20128 Milan, Italy Telephone +39 02 27075-1 www.heidenhain.it

in-depth assessment and forecasts. This allows you to cut inefficiencies while still sitting around a table, and to organise work not just on an individual machine but also for the entire facility. The different levels of the PAMA software offering range from the simple extrapolation of data for an individual machine and their processing to the management of the single cell or machines in the system or even to interconnection of the entire workshop with the consequent advantage of organising all the tools and production programmes.In this case, the system lets you personalise ad hoc for the customer, integrating all removable capability into one single tool.

Today already at its second release in a "suite" version, PAMA's PR2 system allows a considerable increase in the process efficiency thanks to smart predicted management of production needs, making it possible to fully load the machines and optimise the resources available, reducing the ROI time and lowering operating costs even for the entire workshop.

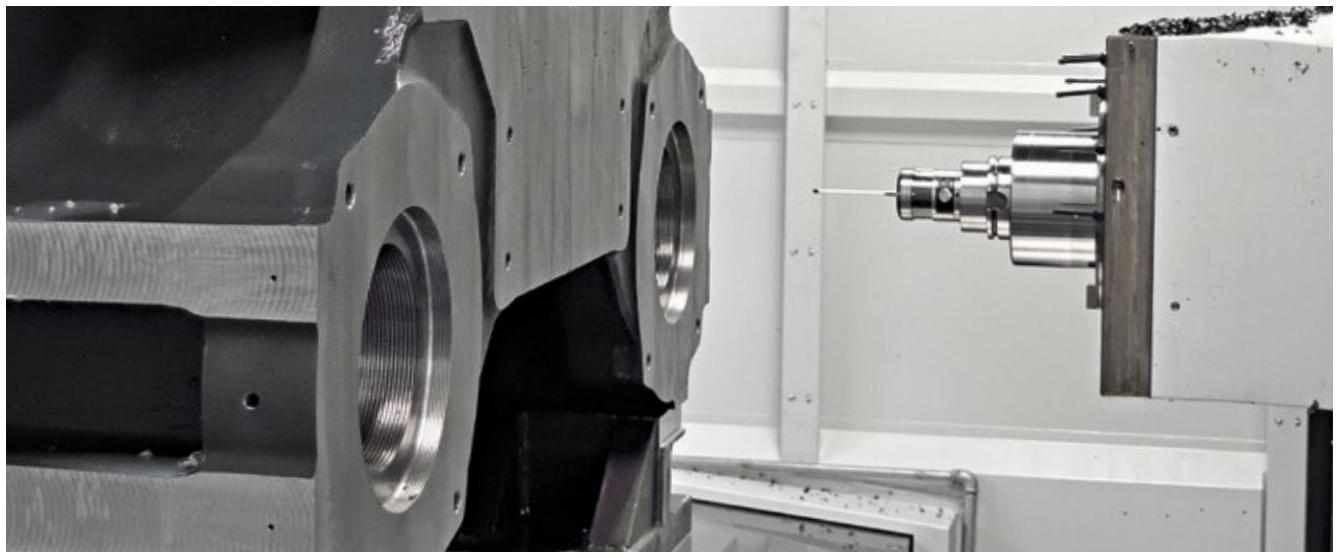
More efficient manufacturing in KraussMaffei plastics machine construction

PAMA TABLE TYPE BORING AND MILLING MACHINES FOR THE COMPETENCE CENTRE FOR CAST PLATE MANUFACTURING IN INJECTION MACHINE CONSTRUCTION

The substitution of plastic components for metal elements is proceeding unabated. This is good for manufacturers of plastic machinery. However, they in turn are faced with the task of fulfilling the higher requirements and the shorter machining times of the market. Streamlining and technology development are popular. The current trends include a growing proportion of additives in the plastics used, placing greater demands on plastics machine construction. KraussMaffei Technologies GmbH in Munich is in a good starting position. It offers three expanding machine technologies from a single company for the plastics and rubber production and machining industry: Machines using injection moulding technology, reaction process machinery and extrusion technology are produced in the factory workshop in Munich. In addition, factories operating in Sučany in Slovakia, by Netstal-Maschinen AG in Switzerland and by the KraussMaffei Group in Haiyan in China manufacture injection moulding machines. 70 to 80 percent of products are exported worldwide. These machines are used for medical, cleanroom and automotive technology and by the packaging industry, among others.

Centralised in-house manufacturing of cast platens

KraussMaffei Technologies GmbH in Munich manufactures all technically advanced components, such as heavy cast platens, injection housings and sliding and positioning shoes, in its in-house workshops. The platens mount the injection tools in injection moulding machines. This means that they are one of the components that help determine quality. To ensure the quality



and the required manufacturing volumes of these platens, KraussMaffei Technologies GmbH decided two years ago to establish a competence centre for the manufacture of these cast plates. This required new machine tools, and a call for tender was issued as a result, with specific specifications. These specifications included that: The cast plates were to be machined in a horizontal position. The machines were to be provided with complete casing and a flue gas and mist extraction system. The workpieces were to be clamped and unclamped during the production process. A telescopic drilling spindle (quill) was required for deep penetration of certain workpieces, such as when machining injection housings. The main machining operations were to be carried out with only two clamping positions as far as possible. That is only possible using an angle milling head, which enables machining at the required levels of precision. A large tool magazine was also required to enable the tools to be automatically swapped into the spindle and the angle milling head. The angle milling head also needed to be automatically fetched from a pick-up station and transferred to the spindle. “Another requirement,” explains Traian Peter Paven from the Industrial Engineering division, “was that the layout of the machine needed to be symmetrical, so that two machines could be placed next to each other and the operators could work together in an ideal way. PAMA met all of these requirements.”

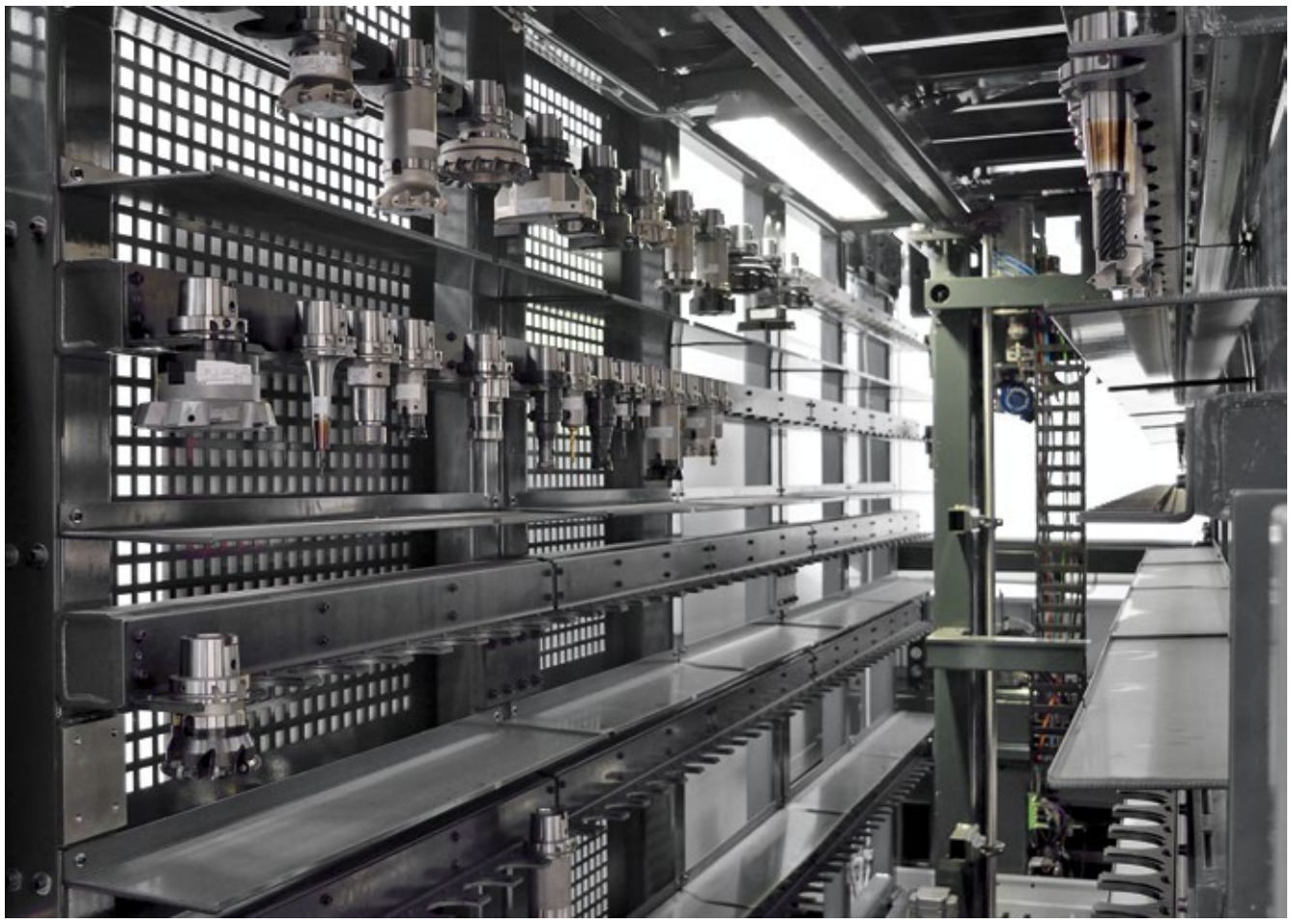
Good cooperation is the recipe for success

When KraussMaffei Technologies made the decision to establish the competence centre for plate machining, PAMA had just finished building the first table type boring and milling machine of the “SPEEDMAT 2” model. “After we made the decision to invest in a PAMA product,” explains Traian Paven, “this machine formed an excellent basis for developing a general requirements specification for other machines. Excellent cooperation with PAMA as well as with Siemens, the control system specialists, enabled us to use the PAMA standard machines from the SPEEDMAT HP modular kit to configure

three machines to perfectly suit our production interests. We worked together to develop new technologies, enabling us to achieve the agreed increases in productivity and ensure high machining accuracy."

Technological leap from the SPEEDMAT 2 to the three SPEEDMAT HP machines

The SPEEDMAT range of table type boring and milling machines and machining centres consists of four basic models with drilling spindle diameters of either 130 or 160 mm and pallet sizes of 1250x1250 to 2000x2500 mm. The SPEEDMAT 2 supplied in 2012 offers two exchangeable pallets with a size of 1600x1600 mm and a table load of 16,000 kg. To ensure that the system operates with stability and to reduce vibration, all of the main modules are manufactured using cast iron. The turntable moves over the B-axis, which has a hydrostatic guidance system. The pallets, which mount the workpiece, can handle loads of up to 12,000 kg. The W-axis (quill) provides a stroke of 800 mm. The tool magazine provides 316 spaces. "The modular configuration of the machines gave us the basic assurance that PAMA can meet even higher requirements. When we worked together with the PAMA experts involved in the project during commissioning," emphasises Traian Paven, "we were able to see exactly how much potential there was, which actually then enabled us to set up the three new machines to meet our requirements exactly.

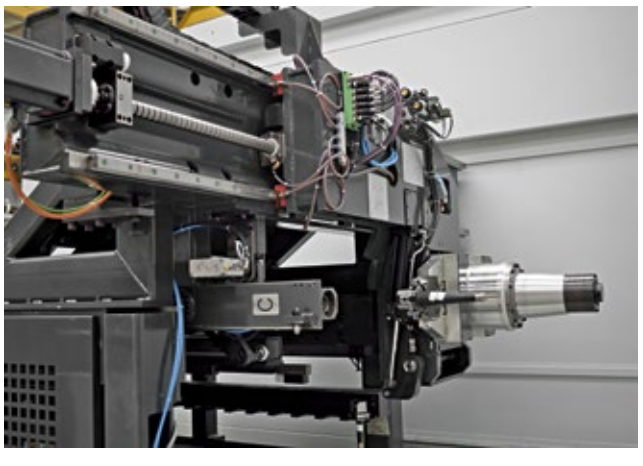


First, PAMA installed the smaller machine – a SPEEDMAT HP 3 – from the SPEEDMAT HP product line, which consists of 7 basic models. In accordance with its intended tasks, it is equipped with exchangeable workpiece pallets with a size of 1250x1250 mm. They can be loaded with workpieces with a total weight of 8000 kg (including equipment). The drilling spindle diameter is 130 mm. Installation of the third and fourth machines, a SPEEDMAT HP 5 and a SPEEDMAT HP 6 with a layout symmetrical to the SPEEDMAT HP 5, began just two weeks later. PAMA experts, Siemens control system specialists and all of the KraussMaffei employees involved in the project worked together so efficiently up to this point that the three SPEEDMAT HP machines were delivered with technological capabilities that they had never previously possessed.

"The innovations," describes Frank Seifert, Sales Manager at PAMA, "included the new machine covers that make production quieter, filter the exhaust air and provide protection against flying chips. We developed a new tool magazine that enabled large and wide tools to be inserted with greater efficiency. We created new software. In addition, the SPEEDMAT HP machines were updated to use the new CNC SINUMERIK 840D sl control system. We included various machining cycles, which we developed further in collaboration with Siemens and KraussMaffei. For instance, one of the cycles integrated into the control system is Cycle800, which significantly simplifies programming of the movements of the angle milling head for machining in different layers. We have reduced chip to chip times by optimising tool changing times and changing times of angle milling heads. In addition, we were able to create the conditions to enable the angle milling heads to be swapped between all four machines, including the SPEEDMAT 2, if necessary."

High production output

To start with, the machines work in three shifts, which ensures not only that the investment can be recouped quickly, but also that the volume of orders can be processed reliably. For this reason, each PAMA machine tool machines a specific assigned range of components. In principle, technically advanced components such as sliding and positioning shoes, injection housings and plat-



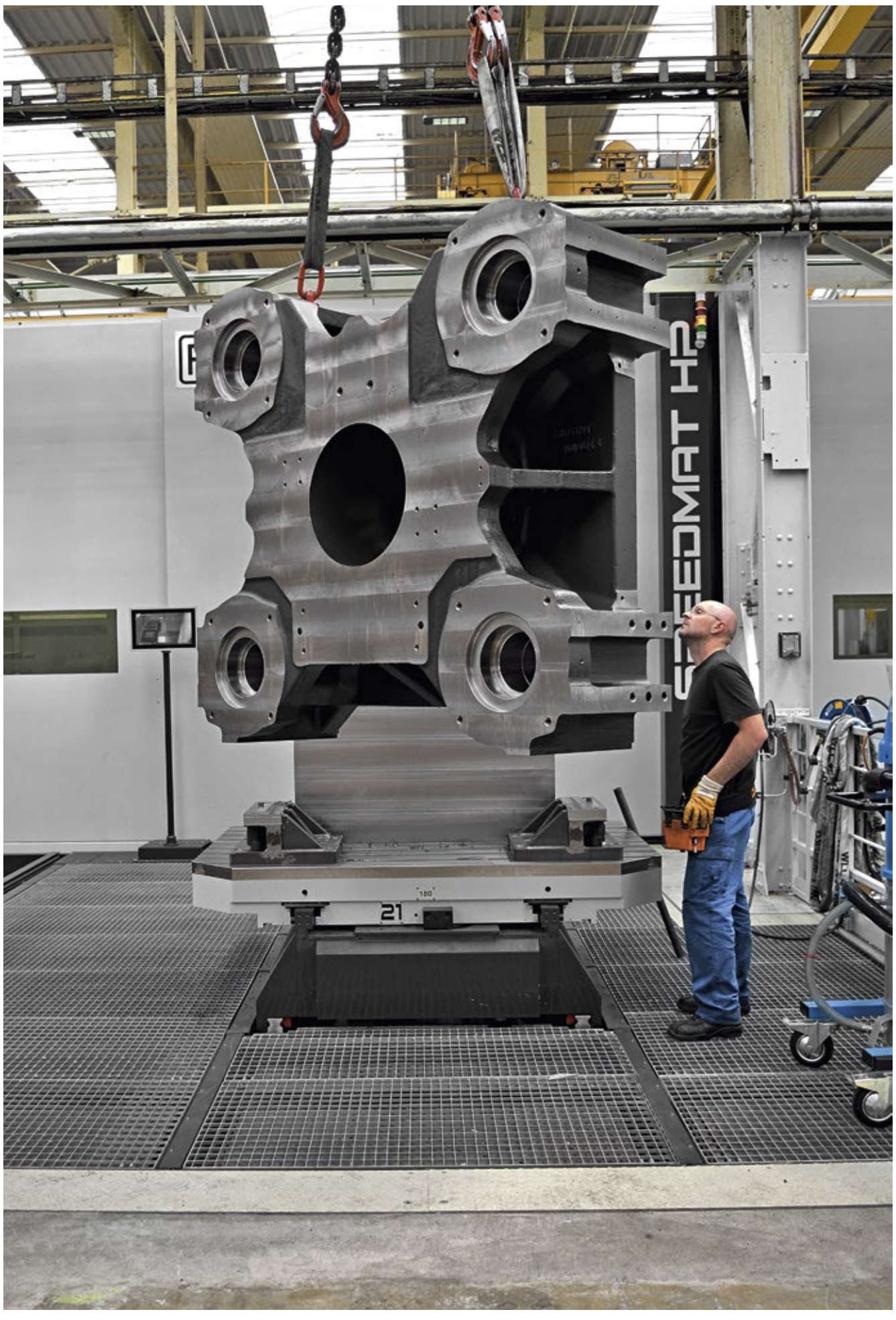
ens are manufactured in the workshops in Munich. The first machine, the SPEEDMAT 2, is used to machine housings for the injection unit of the injection moulding machine, among other things. “Even then”, explains Production Manager Dr.-Ing. Marc Lotz, “we were able to achieve significant time savings. Firstly, the use of the angle milling head enabled us to reduce the number of clamping positions required from three to just two. In addition, we were able to reduce machine downtimes by setting up the workpieces on the exchangeable pallets during the production process.”

The large machines, the SPEEDMAT HP 5 and 6, machine the heavy cast plates for the clamping unit of the injection moulding machine. Here, the exchangeable pallets for the workpieces are 2000x2000 mm in size and are designed for loads of up to 20,000 kg. The longitudinal travel of the turntable on the X-axis is 3800 mm, and the longitudinal travel of the stand in the Z-direction is 3200 mm. The headstock moves along the 2500 mm-long Y-axis. The drilling spindle (W-axis) offers an axial travel of 800 mm. This machining area enables the heavy machining and finishing of the cast plates to be carried out in three clamping positions: First, the narrow sides are machined while clamped lying flat. This creates the conditions to enable precise clamping in the second and third clamping positions, which enable the front and rear sides of the cast plates to be machined in a vertical position.

The table moves rapidly, at speeds of 25,000 mm/min in the X-direction and 30,000 mm/min in the Y-axis and Z-axis. The clamping position is changed from the second position to the third position using a crane. To ensure high machining performance, the 160 mm spindle of the SPEEDMAT HP 6 is powered by a 52 kW motor. To provide cooling and flush out chips, the machine is equipped with a coolant system, which pushes coolant through the tools at a pressure of 60 bar and a rate of 20 l/min and supplies it externally onto the machining point at a rate of 70 l/min and a pressure of 8 bar. If the automatic angle milling head is required for a machining operation, the machine requires a maximum of just 90 seconds to carry out the entire changing procedure (automatically removing the cover panel from the headstock and supplying a milling head from the pick-up station). The benefits of the in-house manufacturing of the angle milling heads by PAMA, which are therefore ideally suited to the machines, become clear here.

The new tool magazine also contributes to the high productivity. It provides a total of 400 spaces. A linear robot moves inside the magazine for loading and unloading the tools. This robot transfers the tools that are to be replaced to a tool changer, which removes the tool or probe that is to be replaced from the spindle and transfers the new tool/probe to the spindle using its double gripper.

The magazine is equipped with a rotating door which enables five tools to be manually loaded and unloaded simultaneously, to ensure that tools can be replaced in accordance with the work order or once they have reached the end of their tool life. To ensure that the tools can be loaded and unloaded during the production process without caus-



ing any disruption, a monitor is installed next to the rotating door. This monitor provides the operator with information regarding the machining process in the workspace.

Reliability of order processing

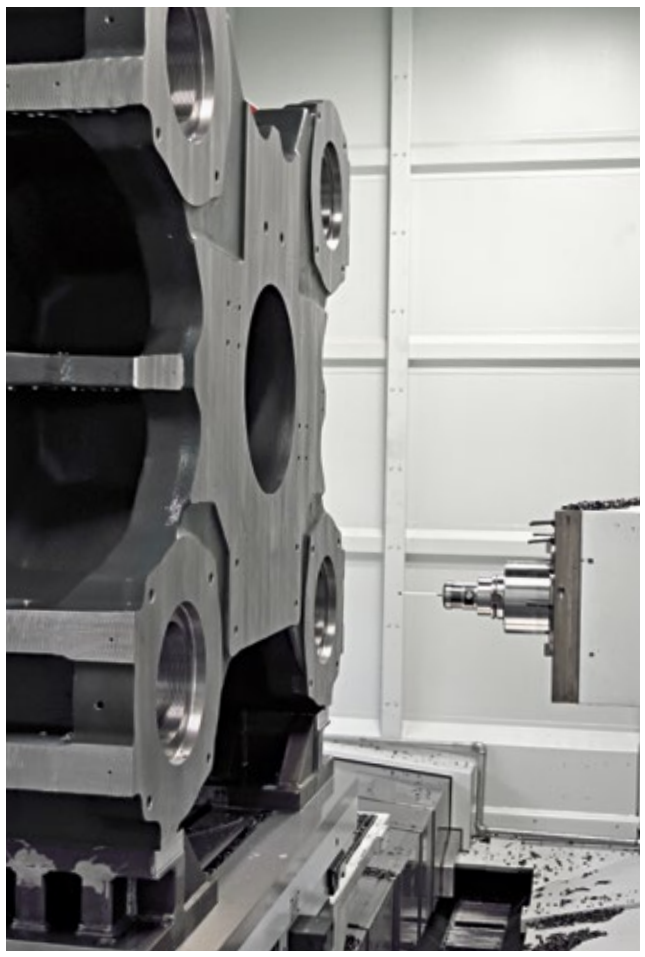
"Each of our plastics machine tools," emphasises Traian Paven, "is manufactured in accordance with the order that we receive." The design department develops the 3-D drawings and transfers them to the production planning and programming departments, who generate the CNC programs. A simulation is then carried out, which helps to prevent collisions, among other things. When these sub-steps are carried out, a machining program is produced, which is sent to the internal server. Alongside this, the production planning department develops the clamping sketches and the tool lists. All of the machine tools at KraussMaffei are integrated into the internal PC network. Alongside the work order, the operator retrieves the preset NC program, the clamping sketch and the tool list from the server.

During machining, the operator can modify the program during the initial run in order to optimise the machining process. These modifications are then discussed with the programmer. If the changes are accepted, they will then be transferred back into the server after the machining process is completed. They will not remain in the machine control system. This ensures that operators can only use programs that have been properly maintained and are up-to-date.

The design details included in the SPEEDMAT HP line to ensure quality also include the hydrostatic guidance of the drilling spindle in the milling spindle. This system ensures that there is no stick-slip effect. This enables the drilling spindle to achieve greater positioning accuracy and register significantly higher damping and stiffness when carrying out processes.

Last but not least, the use of the Balluff BIS-C tool identification system contributes to ensuring reliable machining quality. After machining has been carried out, all of the updated tool data (T-number, geometry data and rated and remaining tool life) is transferred from the control system back to the code carrier and saved when the tool is unloaded.

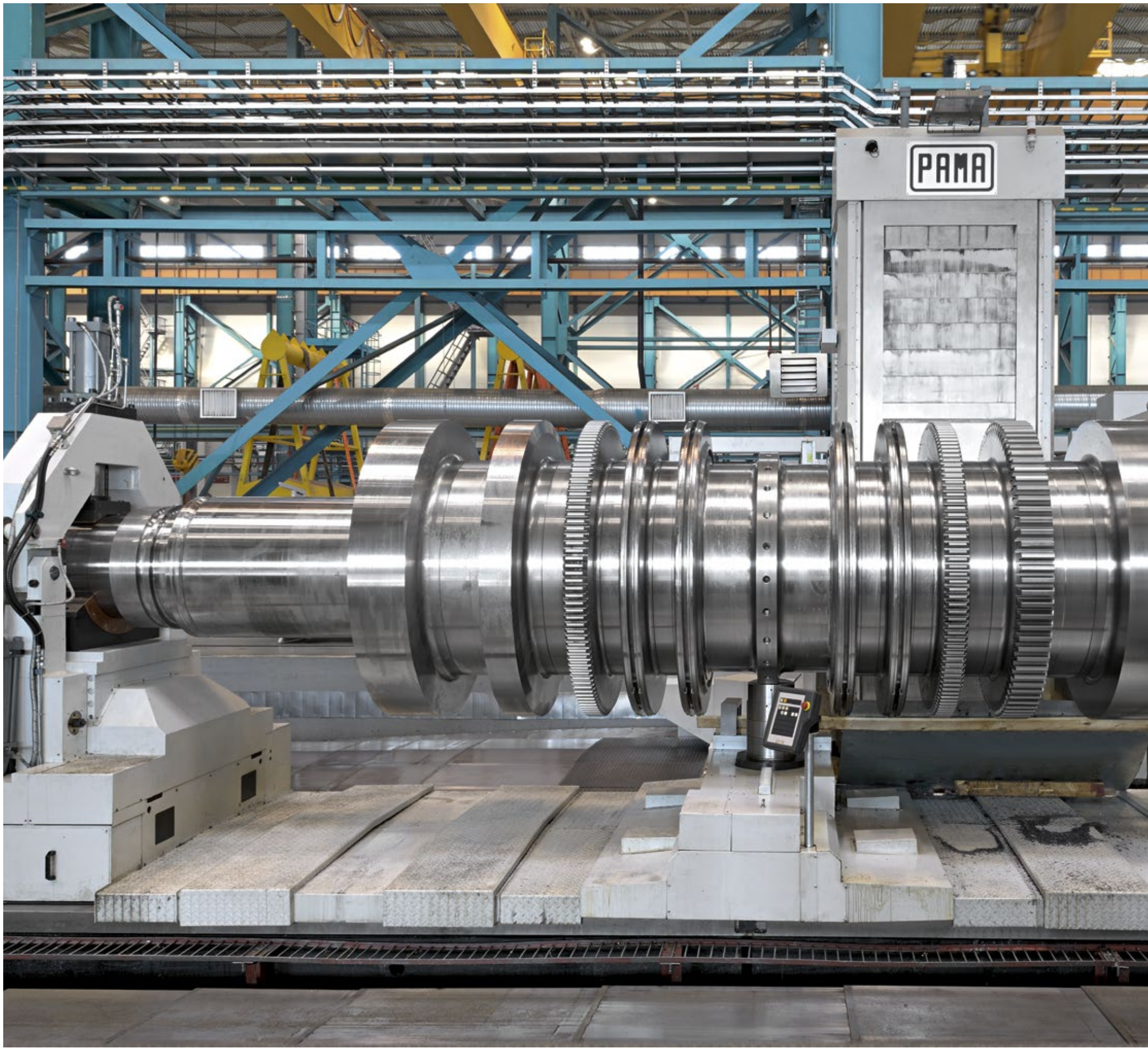
Traian Paven concludes by providing a succinct summary of the assessment of the results that have been achieved: "Next year, we will install our fifth SPEEDMAT-HP machine. Everything needed for commissioning it is currently being prepared in the factory of the KraussMaffei Group Haiyan in China." "This means," reports Frank Seifert happily, "that a positive result for PAMA will once again be achieved: PAMA has sold around 770 machines to approximately 350 customers in the last ten years. This means that each PAMA customer purchases an average of two machines."



high capacity material removal

made to measure for energy applications

IN THE SAINT PETERSBURG PLANT OF THE RUSSIAN GIANT OJSC POWER MACHINES, A GLOBAL LEADER IN THE MANUFACTURE OF TURBINES AND GENERATORS FOR THE THERMAL AND ATOMIC ELECTRICAL POWER INDUSTRIES, BEATS AN ALL-ITALIAN HEART OF PAMA MACHINING CENTRES

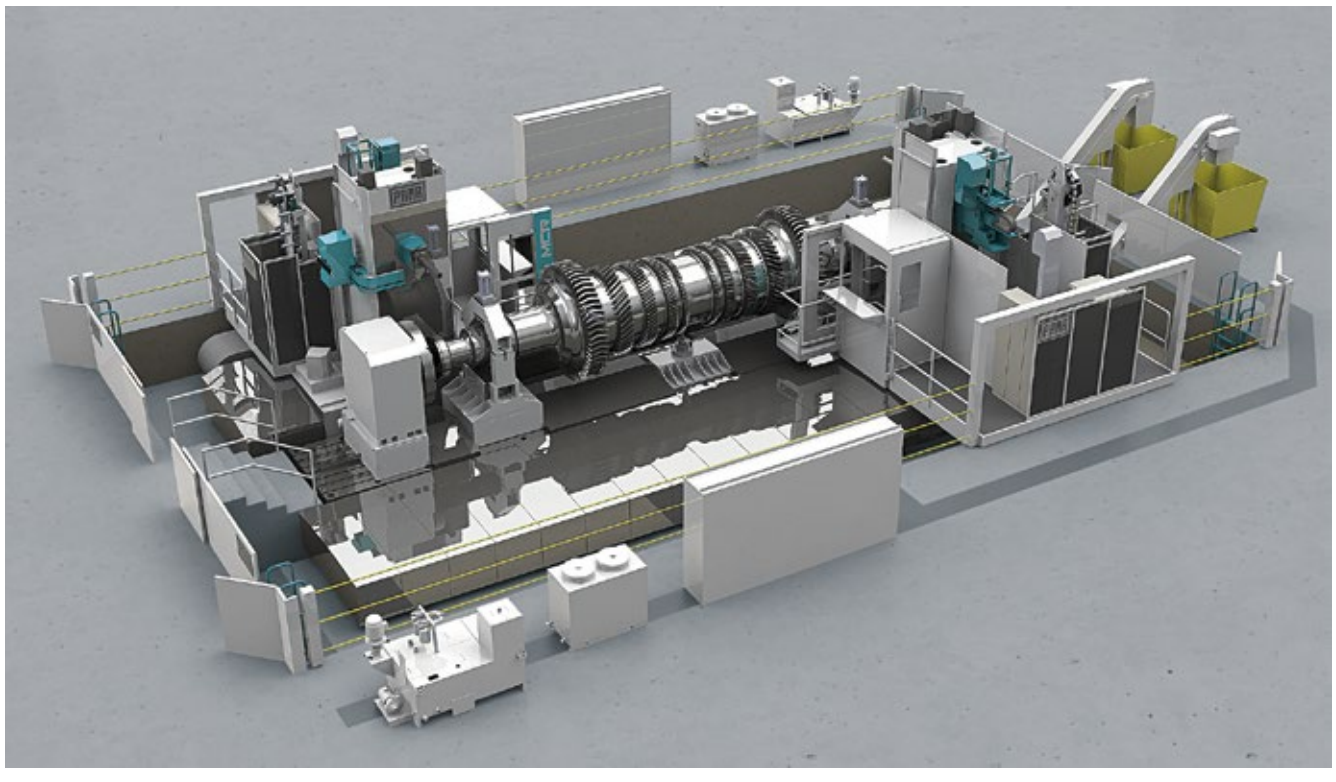


For many of these recent years, the world economy has been plagued by an economic and financial recession. The complex outcome resulted in many businesses struggling to survive, but there remained others capable of withstanding this by rethinking their future: research for the right partners that would support their market strategies and visions.
This was the case for the Russian industrial giant, OJSC Power Machines, a genuine, global leader in the design, engineering and construction of products for the thermal, atomic and hydro-electric power generation industries. So in 2000, a combined partnership of 8 major companies, all with vast experience in this sector of business, was formed and has since been growing stronger and stronger.

The company has to date produced systems for an overall power generating capacity of 300,000 MW, installed successfully in 57 countries all over the world. With over 2,700 steam turbines, 2,550 turbine-power generators, 700 hydraulic turbines and 600 hydroelectric generators, it is the world's fourth largest producer in terms of number of installations. With particularly far-sighted business vision, the OJSC group has chosen to expand its production capacity by building a new plant just outside Saint Petersburg. This new plant boasts an all-Italian heart , as PAMA, a company based in Rovereto Italy, was chosen as the supplier of 2 of the most important machines and factors in the production cycle for a power generation component.
" In Russia, there is an urgent need to renovate existing power generation facilities and this has justified significant investments in this area", explained PAMA Sales Area Manager, Flavio Tosato. "OJSC Power Machines wanted to give itself the capability of manufacturing a broad range of turbines and generators from relatively small units to some of the largest ever produced today. They provided us with detailed specifications, characteristics and the performance required of these machines in relation to the components being manufactured. We then worked from these specifications to conduct a capability study to determine the best suited technological and personalized solution".
This was a major contract award for PAMA, completed successfully thanks in part to its vast experience in boring and milling applications, a knowledge gained over the decades since the company began producing machine tool products in 1926. Worldwide customer commitment has made PAMA become a key supplier to many manufacturing sectors throughout the world as 80% of production is destined for exports.
"The solution we developed for OJSC – added PAMA technical manager Alessandro Moretti – is tailored closely to the needs of the client, which wanted two highly personalised production units dedicated to the manufacture of a specific product. To meet these needs, we realised two separate installations: one for generator rotors and another for turbine rotors. Our exceptional capabilities in the production of machines allows us to give the client exactly what they wanted – a machine exactly tailored in design and in accordance to their current needs foent y lientsand for the next d for the next 20-30 years of production"

MCR, two machines in one

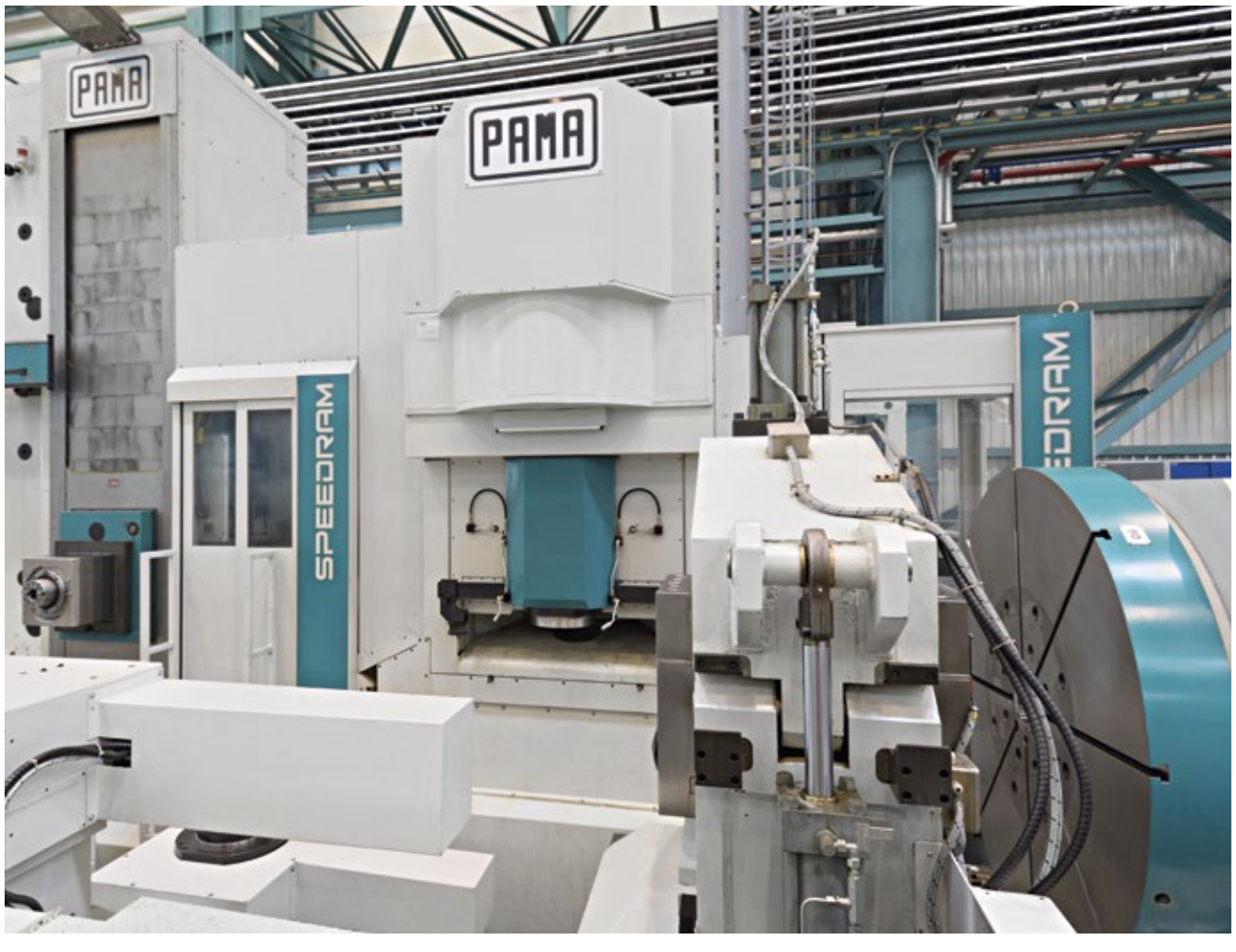
The very wide range of machining capability requested by OJSC was the most critical aspect for PAMA to address in the project when developing the MCR machining center, a design which consisted of two mo-



OJSC Power Machines

bile gantries machining the piece on two different sides.

"A central piece carrier line consisting of a trunnion and two hydrostatic steady rests supports the rotors, which can weigh up to 220 tonnes and reach 3 metres in diameter, with a rotor neck diameter varying from 200 to 900 mm, faces the two milling lines" continued Moretti. "We had to design a structurally very stiff installation, with power and torque levels adequate for the machining procedures and production capacities requested. Each gantry upright is rated at 60 kW, with a spindle speed of 3,000 rpm, and has a longitudinal travel of 15 metres, a vertical travel of 2.5 metres and 1.2 metres of traverse travel." The hydrostatic steady rests play a fundamental role in achieving the tolerances required. These are devices allowing the piece to effectively float on an infinitesimal thin film of oil. This virtually eliminates all friction, resulting in smooth positioning



with no stick-slip phenomena and with total precision.
“This machine has to be capable of working with high performance, high speed tools, but also with conventional tools such as large diameter roughing discs” continued Tosato We took mechanical assemblies that have been developed and thoroughly tested by PAMA and built our machine around these fundamental components.”
This machine boasts an extremely high degree of automation as well”, Moretti continues. “In addition to the automatic tool changing functionality, a number of automatically changed head attachments can also be used, among them an angle headstock for roughing both straight and inclined cavities, which makes use of all of the machine’s torque and power” said Moretti. “Another important aspect is that the piece carrier line is also equipped with special monitoring system which checks each time the piece is repositioned, to confirm that there has been no slippage between the work holding and the piece before resuming the cutting program: an additional check to ensure absolute machining precision.”

Power and precision with the Power Slotter
The production of rotors for electric generators is an entirely different matter. To cut the cavities in these rotors, which are much deeper than on a turbine rotor, a very powerful machine must be used which can not only work with very large diameter mill discs, but can also be used to perform all the machining procedures necessary to complete the rotor (balancing and ventilation cavities, etc.).
“The Speedram 2000 Power Slotter was conceived to manufacturer generator weighing up to 300 tonnes, and measuring up to 1,950 mm in diameter and 17.5 metres in length. An enormous quantity of material is removed when machining these components, as cavities up to 300 mm deep are cut with mill discs up to 1.2 metres in diameter” continued the PAMA technical manager. “In order to do this, the machine was designed with a long carriage moving along the X axis (with a travel of 21 metres) carrying two independent milling units: one consisting of one standard gantry upright from the Speedram 2000 (91kW, 180 mm diameter spindle and ram with 1200 mm of travel), tasked with all supplementary machining processes requiring head attachments, and

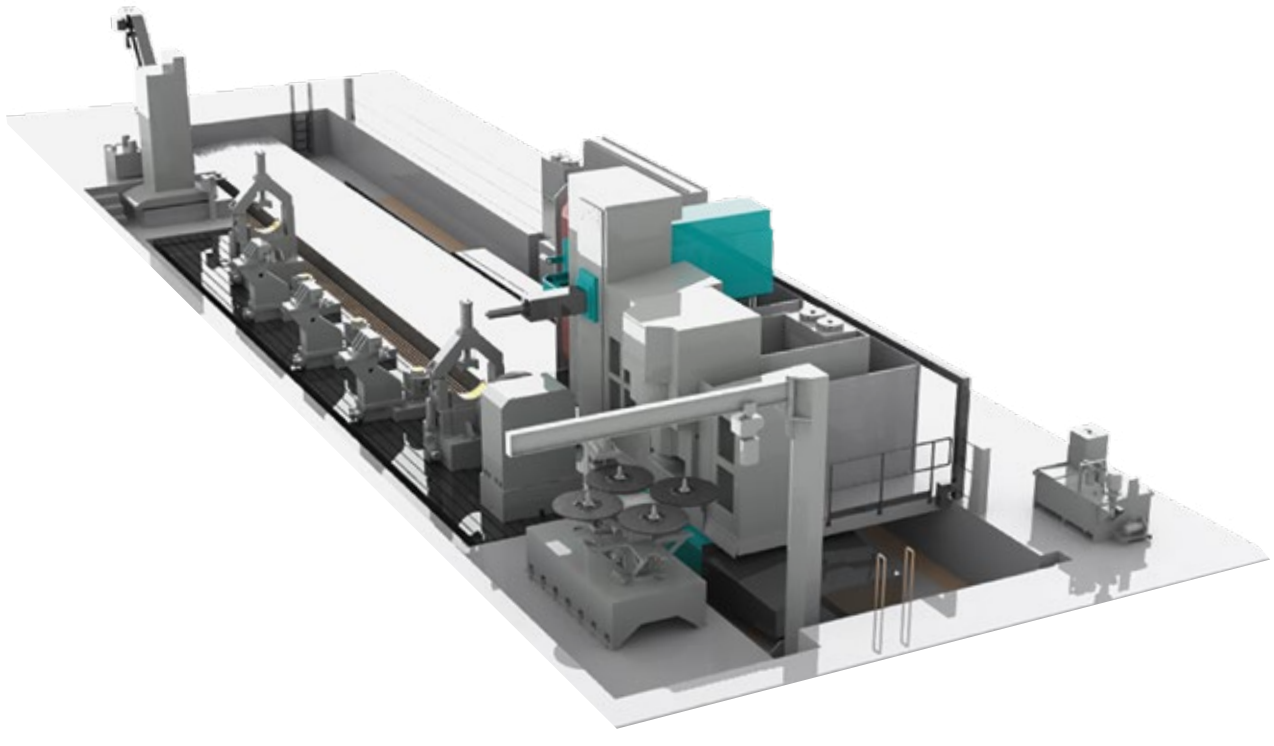
OJSC Power Machines

another dedicated solely to machining cavities, with a transverse travel of 1050 mm and equipped with a 130 kW vertical axis spindle with a rotational speed of 80 rpm, capable of accepting mills ranging from 600 to 1200 mm in diameter."

This machine is also equipped with hydrostatic steady rests - supplemented with up to three intermediate steady rests that are enabled if necessary in relation to the length of the piece - which support the piece during machining and perform two other vital functions: they both keep the piece aligned and counter the machining forces involved. With a particularly stiff turbine, the generator is very heavy but very narrow, and cannot be held in place by the two end steady rests alone, as this would introduce excessive flexing.

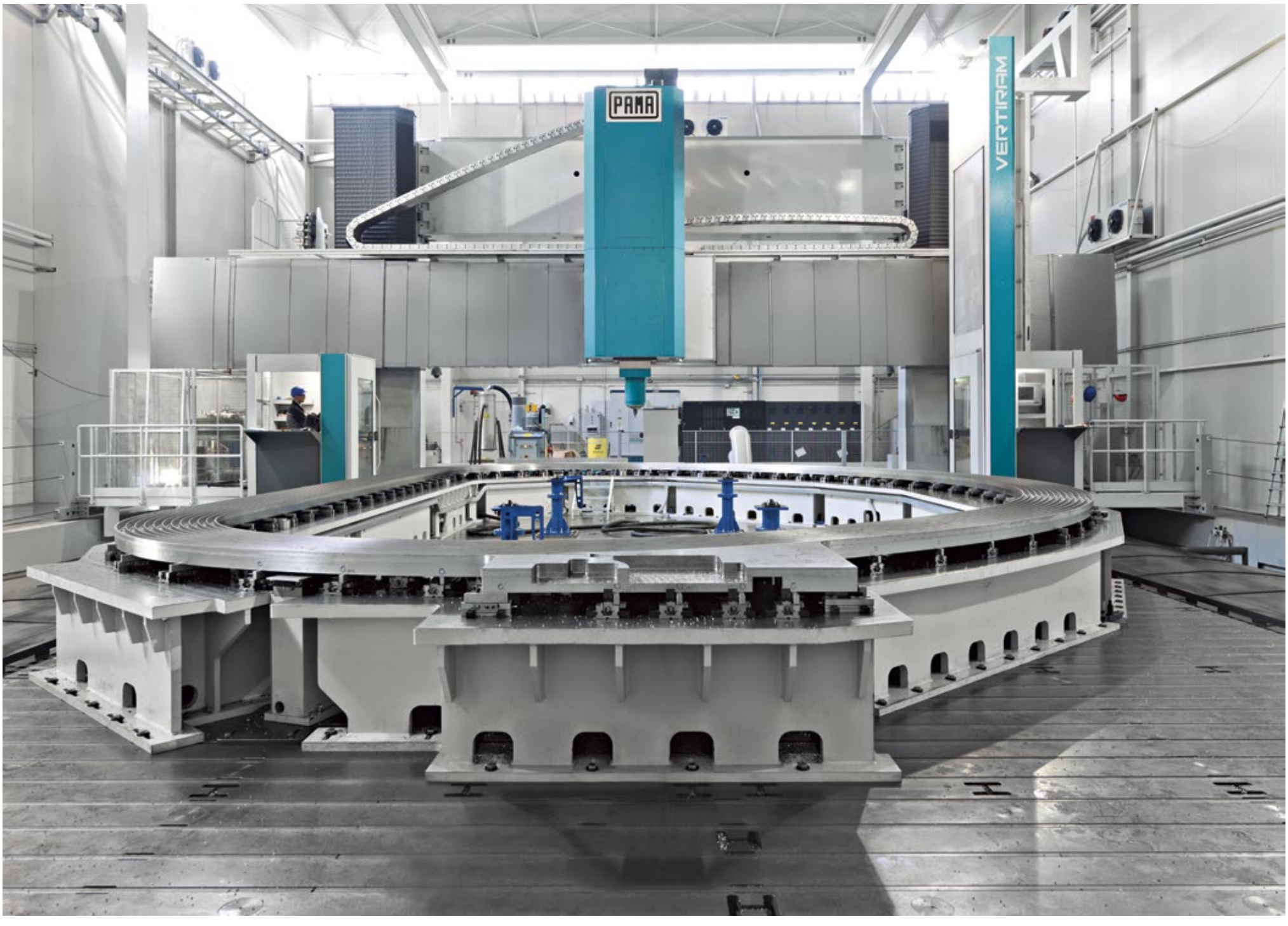
"In this case, the steady rests are micrometrically adjustable, even under load - concluded Tosato – which makes it possible to maintain perfect system alignment even with a 300 tonne rotor fitted."

These very high performance machines made to measure for the needs of the client, are also equipped with every latest safety system. While installed in a Russian plant, both machines are compliant with EC standards and implement all the measures required by European safety directives. The machines are equipped with Siemens 840D SL control units (two for the MCR), which uses Safety Integrated technology to allow extreme flexibility in the management of safety devices in total compliance with legislation, without requiring laborious, inflexible electromechanical solutions.




PAM

radial plates by SIMIC



15 m of precision

Simic has turned to PAMA for the supply of a machine tool that will manufacture a portion of the radial plates, essential components to accomplish atomic nuclear fusion in the thermonuclear reactor of the Iter project. PAMA responded with a customized Vertiram to meet Simic needs of flexibility, high precision and large work cube. Italy has already made a name for itself when it comes to the lack of will to invest in scientific research, which is shameful as we have everything it takes to excel in this field. Italian physicists and engineers are in high demand around the world, and when it comes to designing and creating state-of-the-art facilities we are among the top global players.

Many foreign research facilities not only welcome Italian scholars, but also perform research thanks to the facilities and equipment designed and manufactured by Italian companies. A famous example is the innovative thermonuclear power plant (Cadarache, France), part of the Iter project for which Simic is providing a large number of critical components. In particular, SIMIC was awarded contracts for the manufacturing of 35 Radial Plates and for the supply of 10 TF coils.

Simic has been involved in the ITER project since 2000, also because we strongly believe in this new generation of thermonuclear power stations. This is why we are committed to producing a great number of the components of the main reactor, the Tokamak, such as the divertor which is the element designated to receive the plasma particles that escape from magnetic fields and also serves as a protection for reactor walls. The cassette body, dome, inner and outer target, in other words the parts that constitute the divertor, as well as the prototype and 35 of the 70 radial plates that will form the heart of the reactor were produced by Simic. A radial plate is a D-shaped ring 15 m long and 9 m wide that houses the superconducting magnets required to generate the magnetic field needed to confine the plasma from which electrical energy will be harnessed through a series of transformations.

Uncommon materials

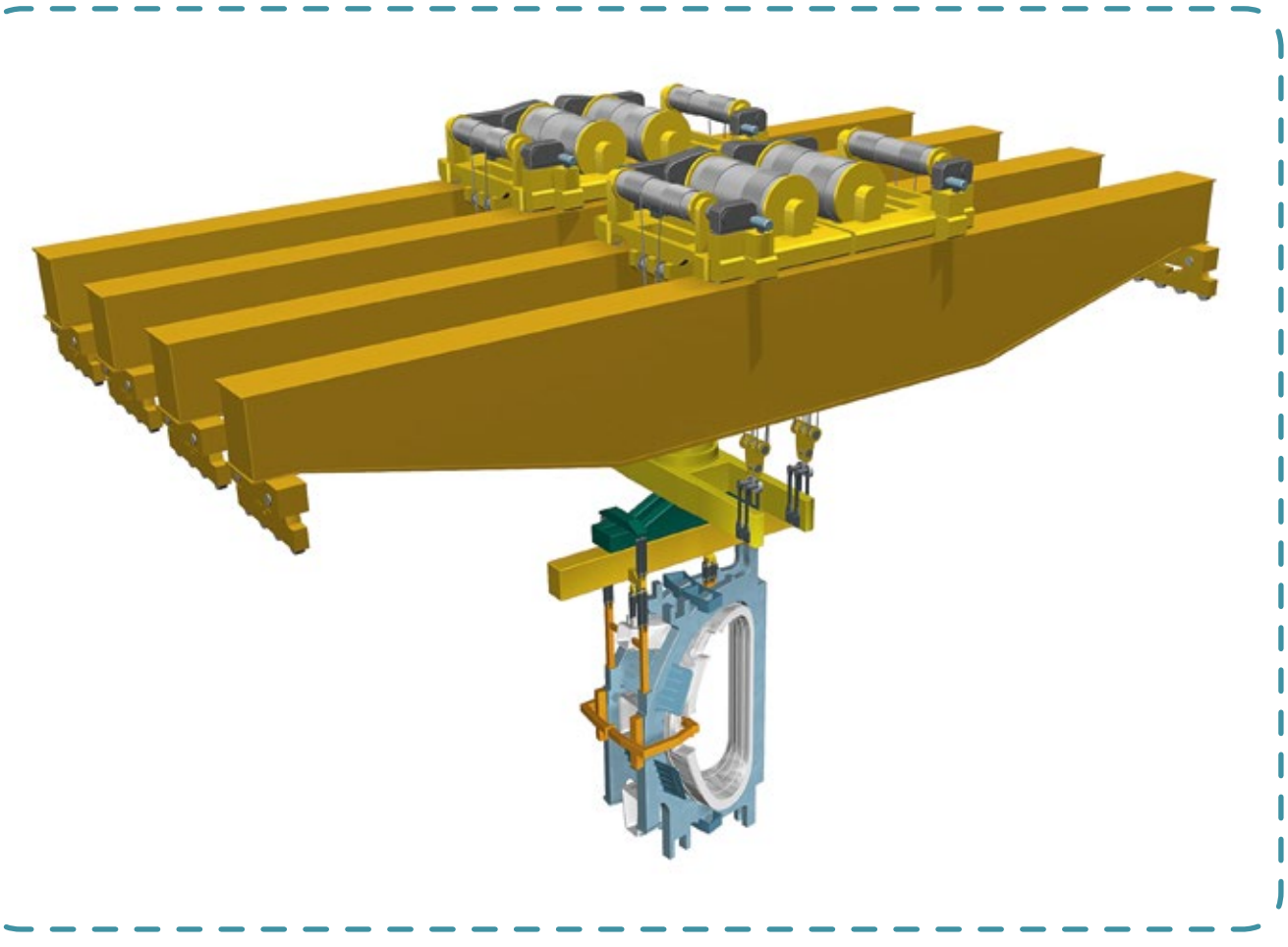
"Our company was established in the 70s and its mission was to meet the demands of the lightweight fabricated structures market as well as to provide installations and servicing for industrial plants. – explains Paolo Barbero, Welding Engineer and Simic Project Manager for the ITER Project - With time the activity has shifted towards the development of more complex mechanical fabrications, pressure equipment and critical components of the process. Simic has evolved over the years and the welding and machining production areas are currently our hallmark of corporate preparation and competitiveness.

The experience acquired allows us to weld all types of material, from carbon steel to low alloy steels, from stainless steel to titanium. We are focused mainly in processing uncommon materials in order to boost our chances at excelling and showcasing our quality!". To achieve this goal the Cuneo-based company relies on its welding department, which develops all welding processes as well as all qualifications for these processes and for its operators. Certified personnel performs daily non-destructive tests on components produced. The high level of qualification that these professionals have is extremely important as various non-destructive tests are carried out, from the simplest and most common with penetrating fluids to the more complex and delicate Phased-Array ultrasound testing and Tofd.

In the machining area, Simic stands out once again for its ability to work uncommon materials such as titanium and nickel alloys. Another strong point is the company's ability to machine very large components still maintaining stringent tolerances required in manufacturing energy components, boilers and pressure vessels. In fact, one of four divisions part of the Cuneo-based company is the critical process equipment and pressure vessels division, mainly engaged in the Oil&-Gas, petrochemical and energy sector. The company also runs a machining division that operates mainly as a support for internal production; the installation division provides mainly plant turnkey systems and is highly active in the food sector; the fourth division, instead, deals with nuclear designs, cryogenics, and high vacuum, as well as with research projects (Big Science Project).

Supporting research

"This division has an important role within Simic and has allowed us to put our name on world-class science projects worldwide. - Barbero continues – for example we have been involved in the ITER project since 2000, also because we strongly believe in this new generation of thermonuclear power stations. This is why we are committed to producing a great number of the components of the main reactor, the Tokamak, such as the divertor which is the element designated to receive the plasma particles that escape from magnetic fields and also



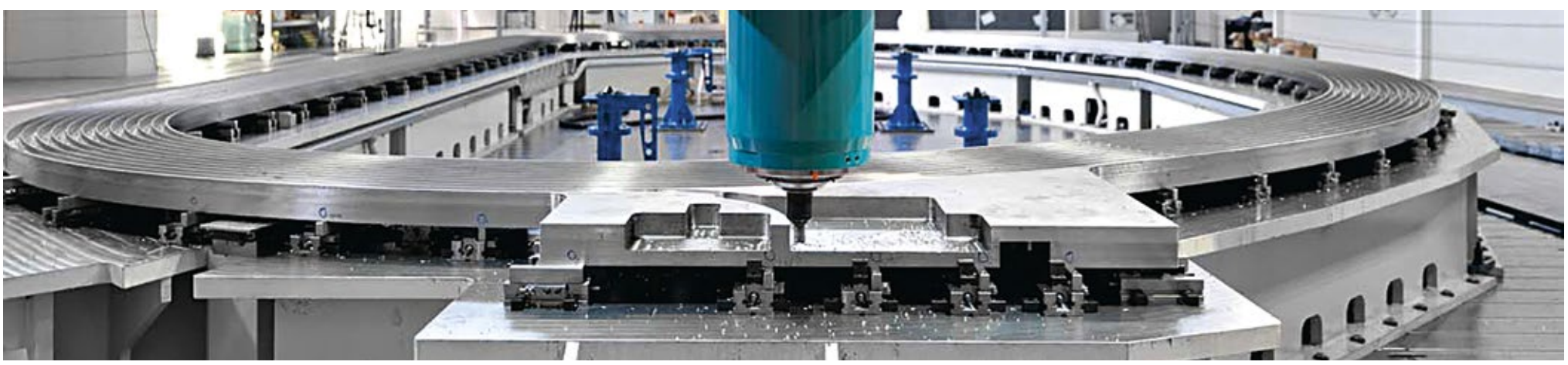
radial plates by SIMIC

serves as a protection for reactor walls".
"The cassette body, dome, inner and outer target, in other words the parts that constitute the divertor, as well as the prototype and 35 of the 70 radial plates that will form the heart of the reactor were produced by Simic. A radial plate is a D-shaped ring 15 m long and 9 m wide that houses the superconducting magnets required to generate the magnetic field needed to confine the plasma from which electrical energy will be harnessed through a series of transformations. Due to the significant dimensions of these parts, the company has decided not to manufacture them in the historical site near Cuneo, but rather in a plant in the industrial area of Marghera (VE) port, which has 6000 sqm of covered area right on the docks with a 30-metre clear height and equipped with fully retractable doors.
"Having to manufacture parts that weigh over 1500 tonnes requires a direct outlet to the sea, which is why we have identified the Marghera site to be ideal for the application. - confirms Barbero - We had already installed a large gantry machine in this facility, with which we used in 2011 to develop the radial plate prototype, but a second was required to perform parallel activities and boost production output."
The solution sought by Simic had to meet several requirements such a large work cube, an very robust structure to accommodate parts weighing hundreds of tons, high accuracy despite its large size and a high degree of flexibility to process parts of different shape and size. We decided to go with Vertiram 7100, the vertical gantry machining centre manufactured by PAMA, which would have been suitable for the application in the standard version , but after a series of jointly designed modifications, has become the ideal solution for our needs. Firstly, the work area was configured to the size of the radial plate, the Vertiram installed in Marghera has axistravel of 18,000x11,600x2,000 mm (X, Y, and Z, respectively), 3,600 mm of vertical travel of the movable crossrail (W axis) 10,000 mm clearance between columns and 5,500 mm of vertical clearance beneath spindle nose. The machine beds and floor plates were adapted and resized to the point that the test on the machine bed was performed with loads exceeding 500 tons.

There are several models proposed by PAMA in the Vertiram line, with two main styles gantry and portal. The standard clearance between the columns varies between 3,100 mm and 7,100 mm, while the clearance under the spindle varies between 2,600 mm and 5,000 mm depending on the model. Other features are (X-axis) that starts at 10,000 mm for the gantry style and the ram vertical stroke (Z axis) with 2 sizes 2,000 and 2,500 mm, with the option of a automatic pallet change for the portal style.
Vertiram spindle has maximum power of 103 kW and maximum torque of 10,730 Nm (100% continuous – S1 rated) and speed of up to 4000 rpm, with an option for Direct Drive (4,000 Nm of torque).
Designed for heavy stock removal on cast iron, steels and titanium alloys, Vertiram is characterised by high precision, high spindle speed, dynamics, automation and flexibility. The wide range of system configurations and accessories guarantees optimal solutions in various fields of application such as energy, construction, heavy engineering, mould making, metallurgy, shipbuilding and aerospace constructions.

Accurate and versatile

"We are also very pleased with the level of precision machining that we achieve with this machine. – said Barbero - The 35 radial plates are in fact similar but not absolutely identical, as internal wall thickness is

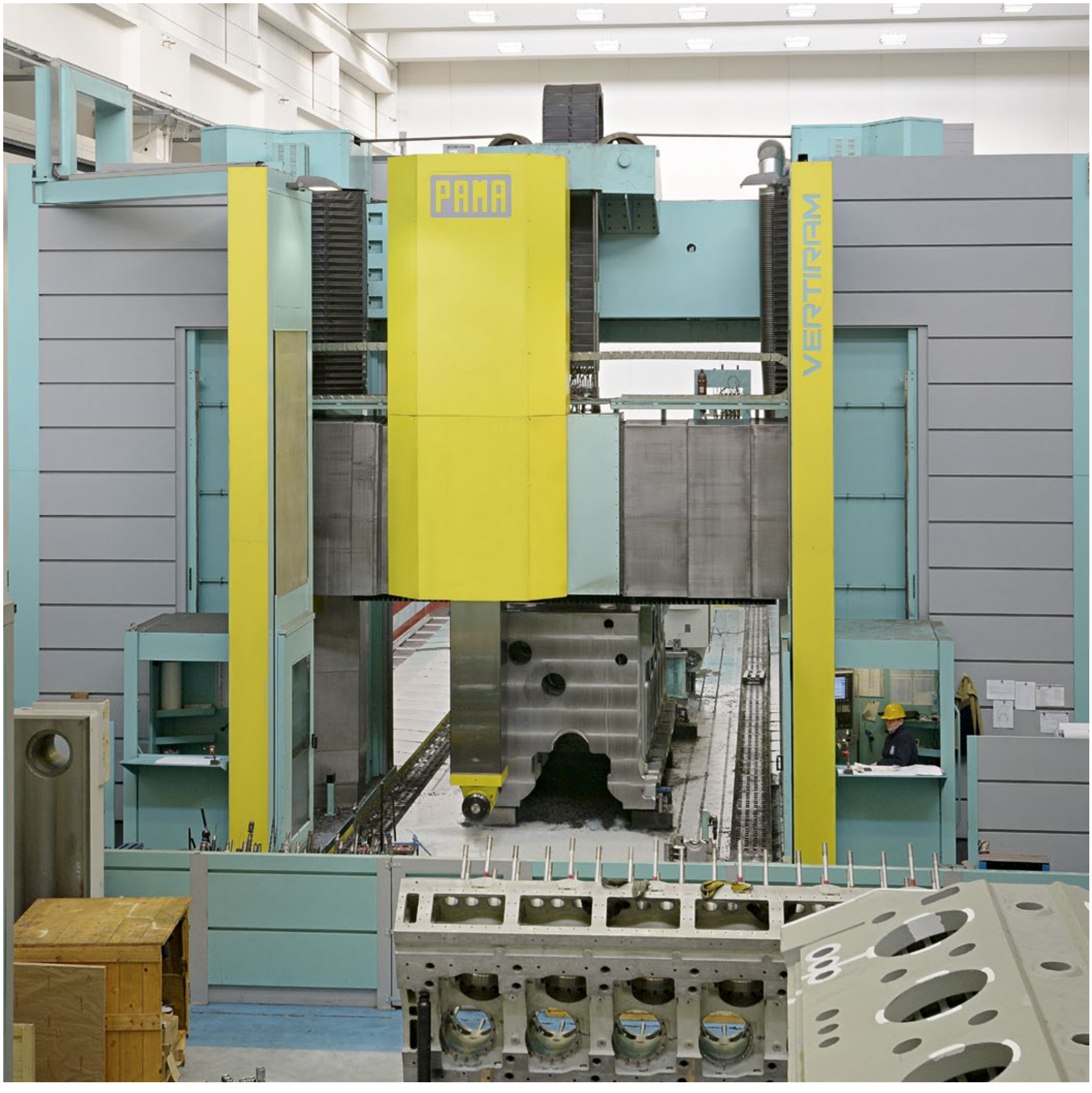


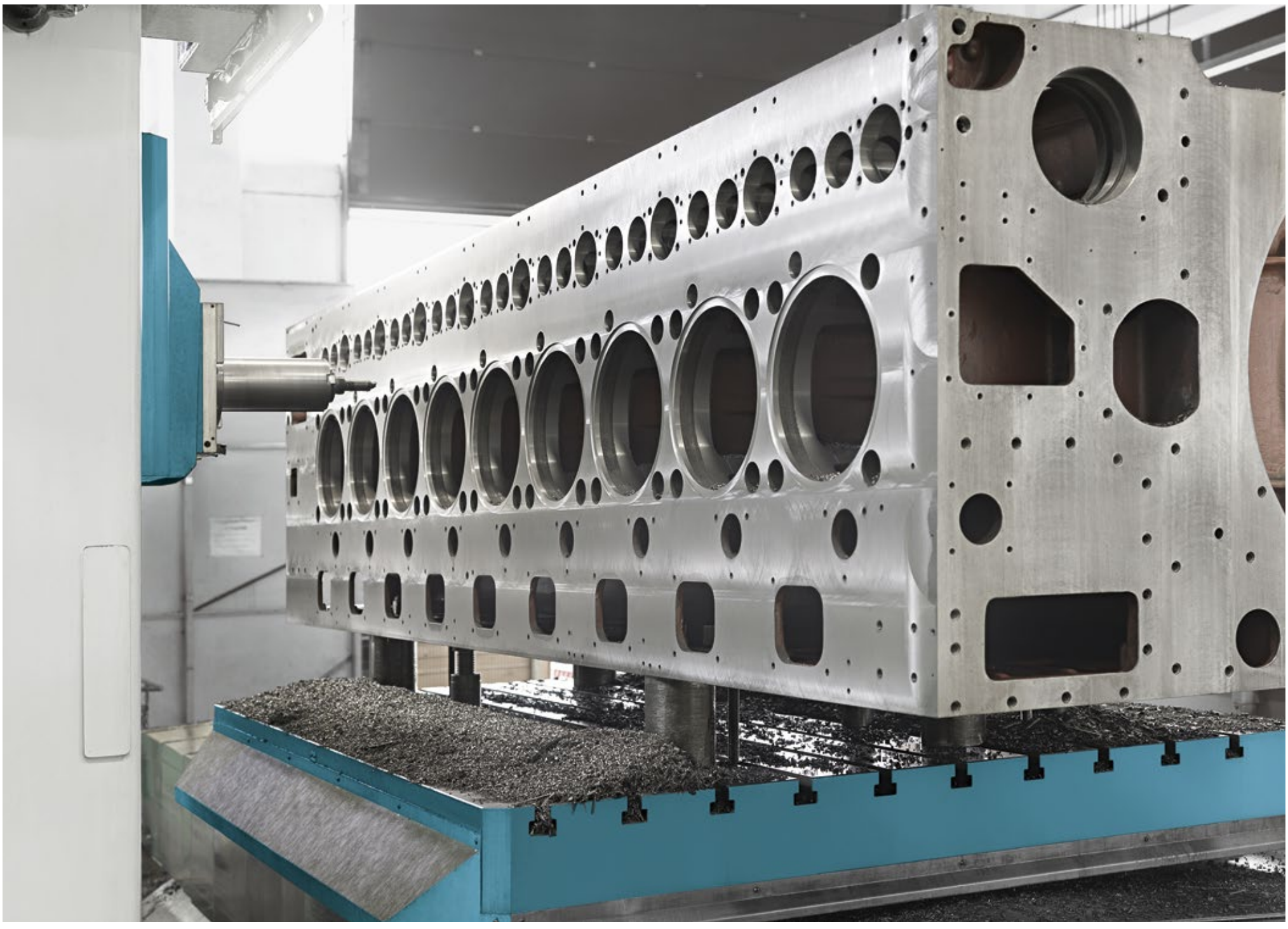
determined by the size of the magnet that will be fit between them. Which is why we have strived to ensure planarity to less than a millimetre, whereas section thickness precision falls within tenths of this measure. An extremely important result considering the extremely large machining travels". This level of tolerance is achievable thanks to Simic's decision to install Vertiram in a temperature-controlled room, where the emperature is kept constant at 20° C 31° C. The ram thermal expansion/contraction compensation system, the incremental linear transducer encoders with pressurisation along the X, Y and W axes and the inductive and incremental encoder integrated into the Z-axis recirculating ball screw further enhance machining accuracy.

"Another important element in the Vertiram choice was the ease of machine retooling. - says Barbero - The machine is equipped with an automatic head changing unit that allows us to quickly switch from an high speed spindle attachment used for rough processing to a spindle nose attachment for boring or to a tilting head attachment." The performance of the Vertiram installed in Marghera plant also relies on a very large capacity tool magazine, as the radial plate are made of 316LN austenitic steel which is an extremely critical material in terms of tool wear, thus requiring frequent tool replacement. The solution adopted allows for quick replacement and offers the possibility of loading twin tools to limit downtime. "Overall, this was a complex project as the machine, though standard, offers a high degree of customisation. - concludes Barbero - In this regard I would like to highlight the important contribution of PAMA, who has followed us in this project step by step and, above all, was able to design, build and install such an important machine in just 12 months."

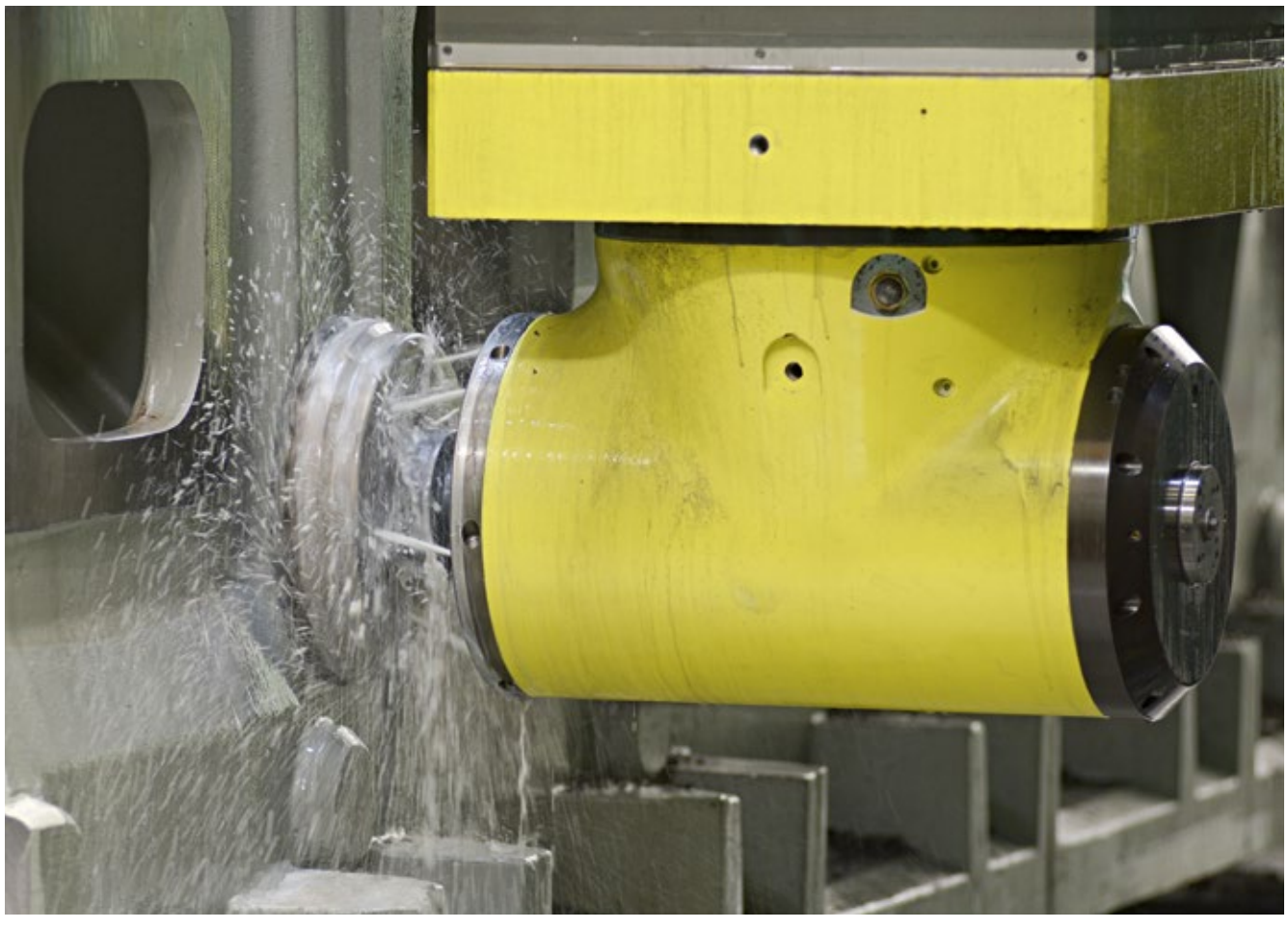
MECHANICAL WORKS MARINE HI-TECH

CUT OUT TO BE MACHINING SERVICE CONTRACTORS FROM THE VERY START, OFFICINA MECCANICA MARA IS NOW SPECIALISED IN MANUFACTURING LARGE MARINE ENGINES. PAMA BORING AND MILLING MACHINES HAVE PLAYED A PART IN THE COMPANY'S SUCCESS. HERE WE WILL FOCUS ON THE VERTIRAM, RECENTLY INSTALLED.

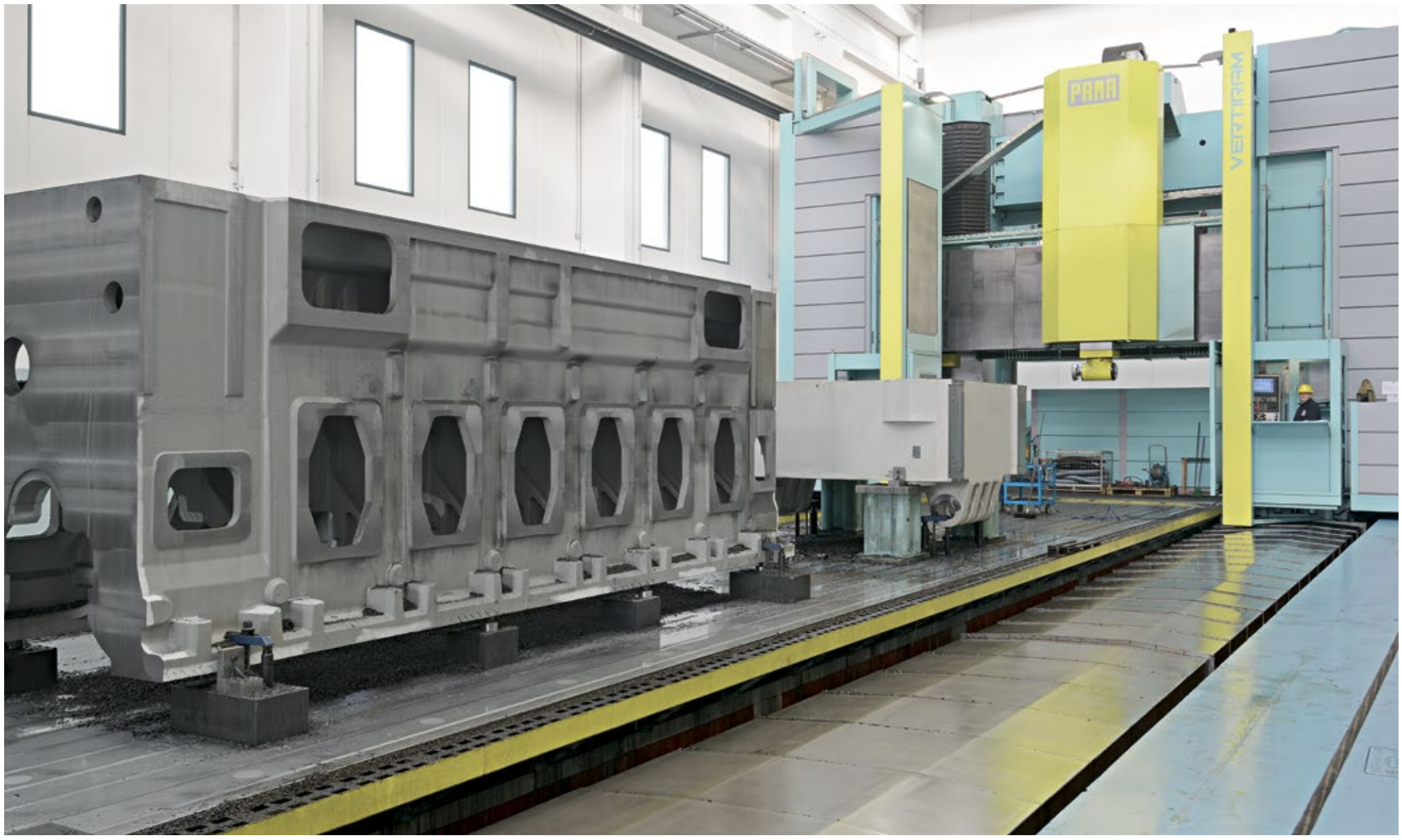




The entrepreneurial spirit of the father, later boosted by the talent and technological skills of his two sons, have made Officina Meccanica Mara an important mechanical and metalworking company active around the world in the marine engine block construction industry. Founded by Gian Mario Mara in 1963 to enter the world of mechanical machining contractoring, this company from Magnago in the Milan area has managed to successfully direct its business and development thanks to the innovative input of Mara's children, Gianni and Natalia. As of 1993-94, they have taken the business from family owned to industrial. The team's professionalism and extreme precision in their work are the main factors that have made a name for Officina Meccanica Mara. While it still performs a small amount of contract machining, it now specializes in the construction of large marine engines which today makes for about 90% of its turnover.



mechanical works - marine hi-tech



Farsighted Corporate Choices

The sector of large engines for nautical applications mainly encompasses products with a high added value. This means that being able to guarantee that they were built with precision is decisive to gaining orders from large multinational groups which compete on the naval engines market in Europe and worldwide.

Officine Meccaniche Mara has a high production capacity of about 1,000 parts per year, between engines and medium and large-sized components, which for large part go to the naval industry, but which are also provided to important customers in the nuclear, energy and wind industries.

The company has always focused on the quality of its products making considerable technological and business achievements at home and abroad being awarded important orders by prestigious companies around the world: France, Great Britain, Norway, Finland, Spain, Holland, Germany, Switzerland, India, USA, Korea, Peru and Saudi Arabia.

When it became focused onnaval applications, the company needed to restructure its organisation and technology, leading to its current setup: a plant in Magnago composed of 3 warehouses for a total of 3,300 mÐ, and a 500 mÐ plant in Vanzaghello, also in the Milan area; twenty-five highly qualified personnel work there, guaranteeing operation during three work shifts for 6 days a week.

“Our personnel,” explains Gianni Mara, the company’s business manager, “is constantly trained with refresher courses within our company or by our machinery and IT suppliers’ on CAD, CAD/CAM and numerical control.

The highly specialised personnel together with the advanced technology of our plants allow us to fully meet even the most critical demands of our customers.

In 2009, when the crisis was at its worst, we launched an investment plan of approximately Ð10 million to build the current structure, equipping it with advanced machinery and plants. It was a remarkable commitment that catapulted us into the world of large naval engines, rewarding our many sacrifices with big orders.”

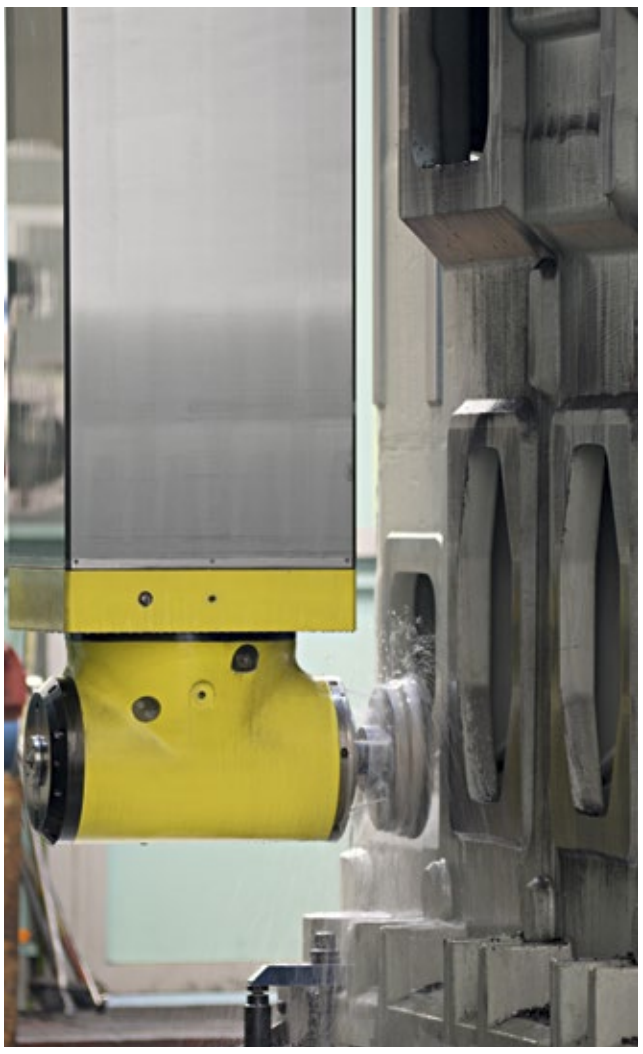
Today, starting from cast iron blanks for the engine blocks, or stainless steel, carbon steel or aluminium for other medium to large-sized mechanical components, the Milanese company can carry out all the mechanical work needed to make the finished product; drilling, tapping, milling and boring on CNC machines that allow complete working of the parts then geometrically checked with laser measurement machines, washed and packaged. There are five bridge cranes with a maximum capacity of 100 tons for handling the engine blocks.

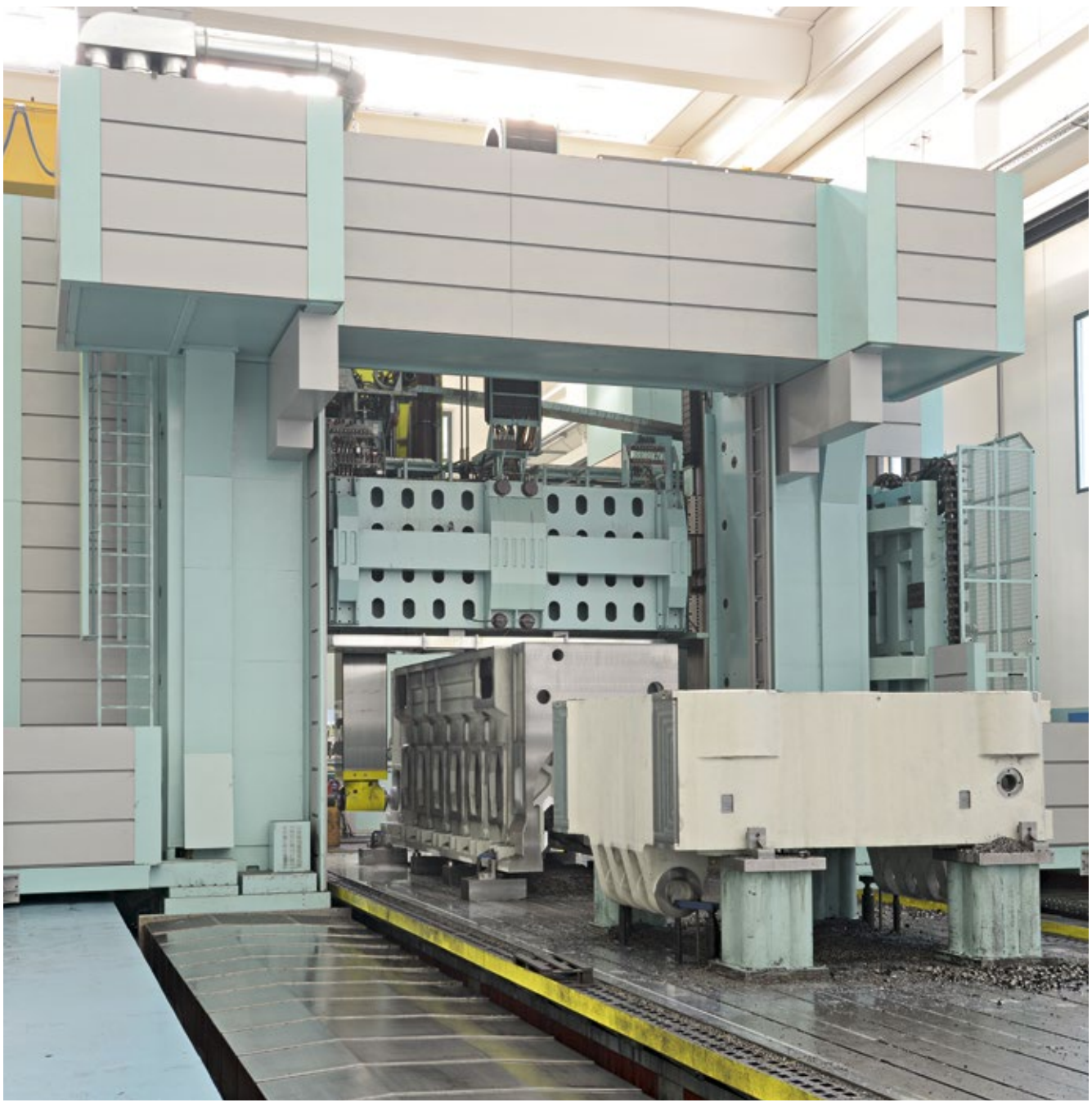
“To properly meet with the production demands for our type of parts, and specifically for engine blocks,” emphasises Natalia Mara, administrative manager and quality assurance manager, “you have to pay special attention to quality, both in terms of company organisation and in terms of production activities. Officine Meccaniche Mara has always believed in quality, and as early as 1995 was among the first companies in the naval industry in Italy to receive ISO 9001 certification by R.I.N.A, which was renewed annually and later was integrated into and extended to the hydrostatic tests based on the customer’s specifications.”

“The fact that our production has achieved a high quality level,” adds Gianni Mara, “is inextricably linked to the advanced technology and the processing precision that our machines are capable of guaranteeing. From this standpoint, great results have been achieved by employing PAMA machine tools; specifically, I am talking about the Speedram 3000 floor type horizontal boring and milling machine, not to mention Vertiram 5100 gantry type vertical machining centre, recently installed.”

Vertiram: A Step up in Quality

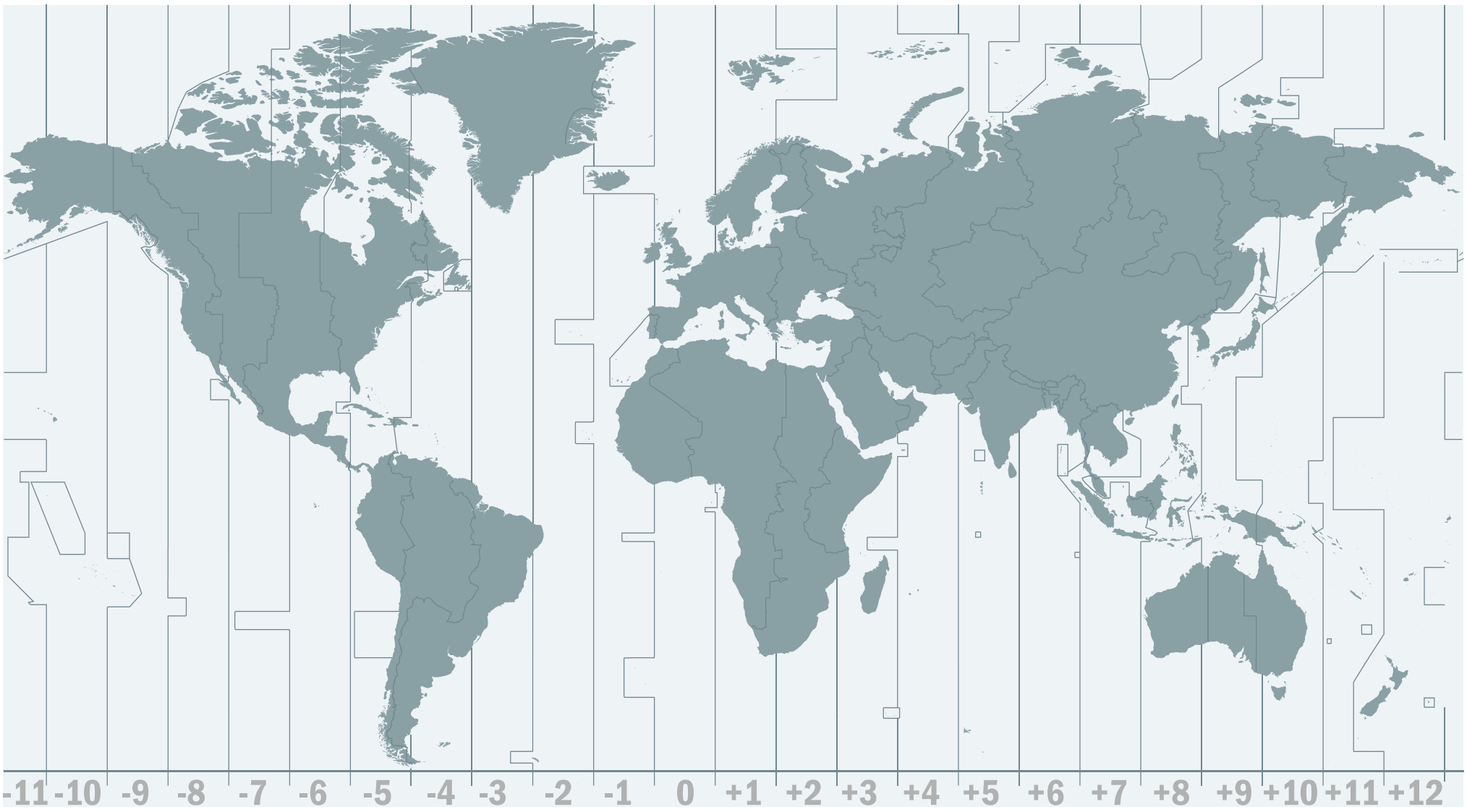
Designed and made by PAMA, the Vertiram vertical machining centres are the synthesis of a tried and proven, robust basic cast-iron structure and innovative technological solutions that guarantee maximum stiffness, high precision, high material removal ability on cast iron and steel and reliability.
The versatility intrinsic to these machining centres thanks to the movable gantry configuration is further enhanced with a complete series of head attachments and machine tools. With X (gantry), Y (head), Z (ram) and W (crossrail) axis strokes of 22,000, 5000, 3000 and 5100 mm respectively, the Vertiram machining centre installed at Officine Meccaniche Mara with Siemens 840 D numeric control has made it possible to optimise the engine block processing cycle in terms of higher precision and reduced downtime. The machine is equipped with a chain style tool magazine with 140 slots and five head attachments specially developed by PAMA to process engine blocks with the automatic head changing system.
“For example, with this machine,” explains Gianni Mara, “on a 12-m long engine we can guarantee tolerance of 0.06 mm and on a 10-m crankshaft we reached precision of 0.03 to 0.04 mm— such high precision can only be reached with the Vertiram.
As early as 1996 we made engine blocks on a Speedram with good results as far as size, but the complexity of the parts required processing cycles with a dozen steps. Today, since with Vertiram you can work 5 faces of the engine in a single placement, we can complete the cycle in just four steps. The consequent benefits are clear: processing times are reduced and the parts are more precise. The resulting increase in productivity is also tied to the extreme reliability of the machine, which is constantly connected to the tele-service letting us work around the clock. Furthermore, with this machining centre we can get ready for the processing of the next part while the machine is running, significantly cutting idle time. Substantially, if we sum it all up, we could say that for 200 hours of tool contact needed to entirely process the engine block only 10-15% is unproductiveidle time, but if we use the Speedram 3000—which already yielded good productivity—you need 300 hours of tool contact, with about 40% for idletime.”
“We are really satisfied with this latest investment,” Gianni and Natalia Mara chime in together, “because we really managed to step up the quality of engine block processing. This satisfaction springs from what the Vertiram’s performance guarantees technically speaking, and is completed by the qualified and timely service of the PAMA engineers, both prior to sale when they perfectly understood our production needs, and after the sale was made as far as training and technical assistance.”





tradizione e innovazione

Italian engineering has always been renowned for the flexibility and ingenuity of its solutions. This time-honoured tradition, together with superlative levels of quality and a corporate structure organised to the most exacting Teutonic standards, have allowed PAMA to establish itself as the world leader in large machine tools.
The precision, extraordinary rigidity and reliability not only of PAMA machines but also of its entire corporate structure have opened the doors for the company to many of the world's most important industrial groups. PAMA can offer the benefits of this extensive experience to small and medium sized machining contractors and businesses, giving them the opportunity to substantially increase their competitiveness in a wide spectrum of different market segments. From energy and heavy industry to the marine and rail sectors, PAMA has always presented itself as a provider of solutions, and not just the manufacturer of top quality machinery. Where high value parts are at stake, having utterly dependable solutions is a significant advantage that makes the difference. The Rovereto based company has recently extended these same principles into new industry segments, in which it has already achieved impressive results and successes. These are aerospace and die and mould, two sectors in which PAMA already has continuous business, and in which the company is geared up to offer its skills and technological expertise. These new strategy has generated developments which have been implemented in recent years, and which has come to fruition at EMO.
Between 2014 and 2015, in addition to implementing improvements to make its existing line more competitive in its traditional sectors, PAMA introduced 6 new machine models to the market, each featuring new technological solutions., PAMA has chosen EMO to present solutions tailor-made for users of machining centres in the aerospace and die and mould sectors, as well as a complete range of both horizontal and vertical multitasking machines. Machines that immediately met with the approval of the market - as proven by the numerous orders already secured. With the automatic head changing capability, feature available across all ma-













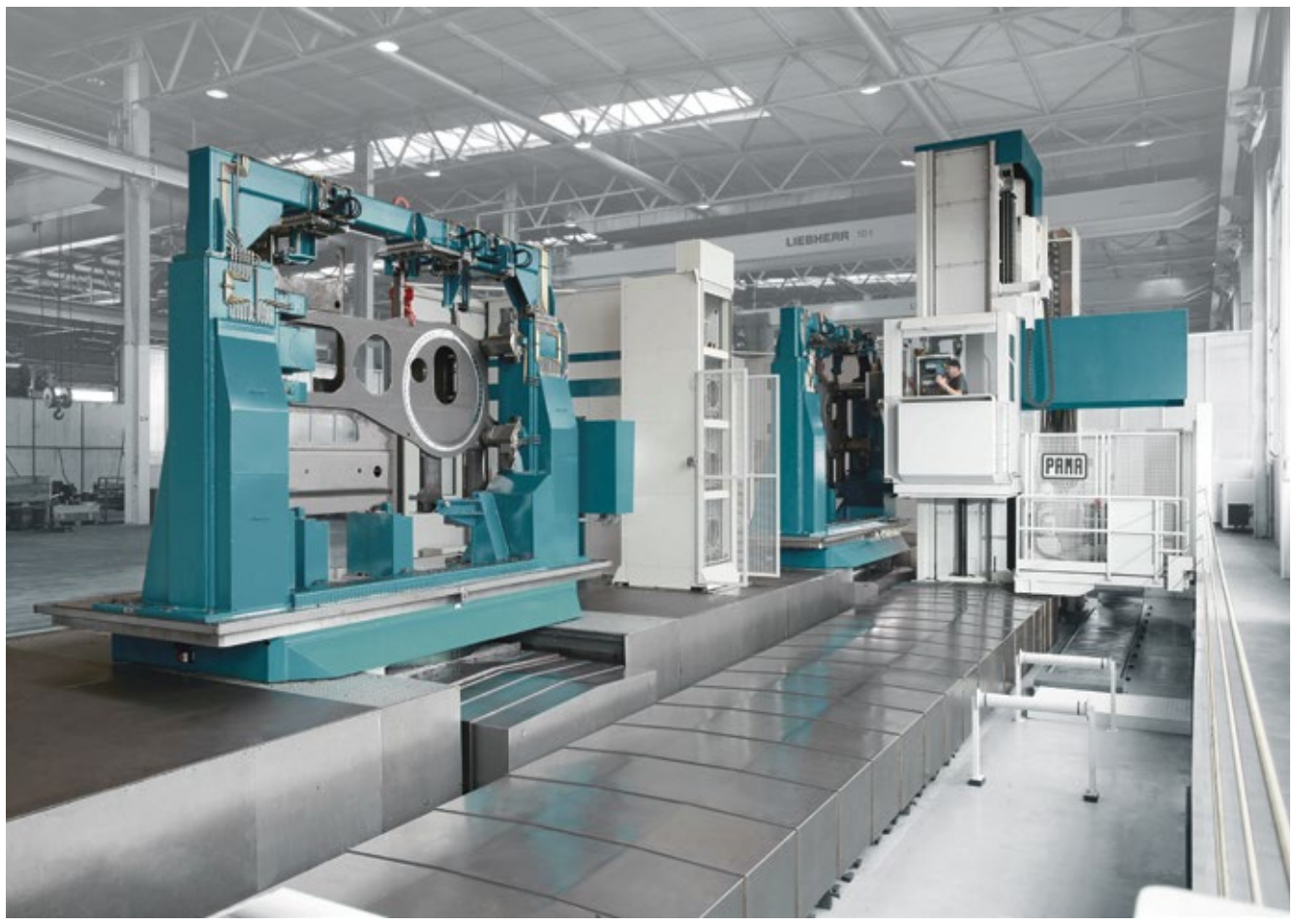

chine models, it becomes possible to machine a part from start to finish in a single set up.
This capability is invaluable for medium and large pieces, which often require very long set-up times followed by extremely complex process to re-qualify reference points.
Technological innovation has allowed PAMA to equip all of its machines exclusively with direct drive spindles, bringing extraordinary results in terms of surface finish, extended tool life and superior material removal capacity. And all of this is possible with just one machine: it has now finally become possible to develop fully fledged machining centres even for medium to large size pieces, significantly increasing the efficiency of production processes. This offers considerable savings in terms of set-up, while the possibility of not having to move the piece again from its initial setting makes it possible to maintain extraordinary precision with respect to design specifications without requiring any particular measures for subsequent centring or to identify and reset references.

An integrated manufacturer

Quality means leaving nothing to chance.
This is why PAMA is a highly integrated manufacturer, which controls every stage in the construction of its machines, starting from manufacturing all main components in its own manufaturing plants, benefiting from the precision and process reliability of its own PAMA machines. This extensive experience also makes it possible for PAMA to hone the performance of its products and technological solutions for its clients. Performing all machining processes in house contributes to the quality of the product, and allows continuous, detailed monitoring of strategic features. And the benefits of this can be seen in the finished result.
The integrated production process also includes the main spindle heads and accessories, which are all manufactured entirely within the Rovereto and Brescia plants. From the 50 kW bi-rotative head and driven right angle head to accessories with integrated high speed spindles capable of speeds up to 30,000 rpm, PAMA boasts a tried and tested range of more than 130 accessory and main heads with direct drive technology for all the machines in the PAMA range - including machines with boring bar - making it the only manufacturer today
to offer such extensive choice.

tradizione e innovazione

ENERGY · OIL & GAS · SHIPBUILDING · EARTH MOVING · DIE & MOLD · GENERAL MACHINING · AEROSPACE



A dependable manufacturer of quality

The principle of lean production was defined by the analysts Womack on the basis of a detailed study of the performance of the production systems of the world's major carmakers, which revealed a distinct superiority of a Japanese producer over all of its competitors. PAMA was one of the first manufacturers in the world to apply this principle for production to order. In particular, this system offers two strategic advantages: cutting flow times for production and, as a result, delivery times, and allowing the integration of the ISO 9001 quality system, which ensures the overall quality of the process and also allows for the progressive elimination of defects. With years of experience using this system, PAMA can accurately and reliably plan order times for the client, while ensuring the quality and precision necessary for a top class product.

A global partner

In today's scenario, as well as the excellence of its products, the competitiveness of a manufacturer is also measured in terms of the support it can offer around the globe. PAMA ensures coverage throughout the world's major markets with a network of branches organised effectively to deliver both after sales services and technical as well as sales support. PAMA has also established a production plant near Shanghai in China, with a substantial workforce and logistics capabilities to offer all-round support to the local market, where itassembles machinery for the Asian market to the same exacting standards as the rest of the group. The client choosing PAMA as a global supplier gains a partner that can deliver localised support, offering the guarantee of superior quality on par with their own standards.

A supplier with tradition, experience and competence

PAMA has long-standing traditions, experience and superior competence in the production of machine tools, allowing it to offer state of the art innovative solutions that give the client a real competitive advantage.
Established over 80 years ago, PAMA has always made quality a top priority. Its philosophy of offering solutions, not just machinery has led PAMA to write countless success stories together with leading global clients, and offer end users the assurance of safe, reliable processes; fundamental factors when dealing with intrinsically high value pieces.

EMO: a strategic event

The latest developments in the range and resulting from the company's continuous investments in R&D will be showcased at EMO, where PAMA will introduce two models joining the production line-up. The main topics for this edition of the expo are innovation (where PAMA has already registered numerous patents) and the ability to machine a complete part with a single set-up.
The first of these two machines, the Speedmill 3000 high speed floor type milling machine, is a top of the line model offering vertical travel up to 4 metres. Featuring direct drive technology, the machine has a centrally mounted headstock with the Y axis run-

ning on two front guideways and two rear guideways with dual ball screws, and a ram on a hydrostatic linear bearing with 8 all-bronze sliding pads, in keeping with PAMA traditions for total quality; a characteristic that makes the difference when uncompromised performance is a must. The X and Y axis move on roller linear bearings, and are capable of travelling at speeds up to 40m/min, with a maximum acceleration of 3m/sec2. The structures of the column and machine bed have been painstakingly engineered to combine the stiffness needed to withstand the 73 kW of power and 1200 Nm of torque of the head, with high speed capability, making the Speedmill a machine ideal for both very high volume roughing and finishing by interpolation. To complete the picture, these machines are also available with an automatic head changing system and a tool magazine capable of withstanding a tool tilting moment of up to 60 Nm.

Together, these characteristics set the Speedmill 3000 apart as the new benchmark for floor type milling machines, especially in consideration of the fact that the work area can also be complemented by products from the PAMA hydrostatic table and TRT turning table ranges. A full 5 axis 50 kW head completes the choice of features for a typical machine configuration.

The second machine presented at EMO is the Speedmat HP2T: a multitasking machining centre which, alongside the Speedmat HP1, is the latest addition to a highly successful line of machines, with hundreds of installations worldwide. This remarkable success is cause for particular pride for PAMA, as the company has only relatively recently ventured into the machining centre sector

. In a configuration intended primarily for the aerospace, oil and gas sectors and for machining contractors, this version introduces a recently patented solution: the turning table. This table allows heavy duty machining jobs with particularly difficult materials at speeds up to 250 rpm, but is also conceived and built to operate effectively as standard rotary table for milling jobs. Usually, choosing a machine that can both turn and mill means accepting compromised milling capability, due to the limited stiffness of a table capable of rotating at high speed. The PAMA rotary table, however, offers more than double the stiffness in milling mode compared to turning mode, ensuring the same quality results as a dedicated machine for both processes. All Speedmat HP machines can also be used with specific turning bars capable of machining even very deep features without the problem of limited tool holder stiffness. PAMA application engineers develop tailor-made processes for each client, introducing more comprehensive options where necessary to complete the process. Whether the client wants to use turning tools directly on the spindle or mounted on dedicated turning head attachments, PAMA will define the most effective and efficient process for every possible situation.

The Speedmat HP machining centre offers a wide choice of possibilities in terms of automation and tool magazine combinations, with magazines capacity up to 770 tool spaces.

The PAMA PR2 system, now already in its second release as a complete suite, further extends the capabilities of the machine by significantly increasing efficiency through the intelligent and predictive management of all production needs (with tool management, machine loading, piece changing programme functions etc.), to achieve 100% productivity and optimise resource usage - shortening investment return times and reducing the operating costs of the entire machine shop.

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PAMA has a policy of continuous improvement of its products and reserves the right to change materials and specifications without notice.

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