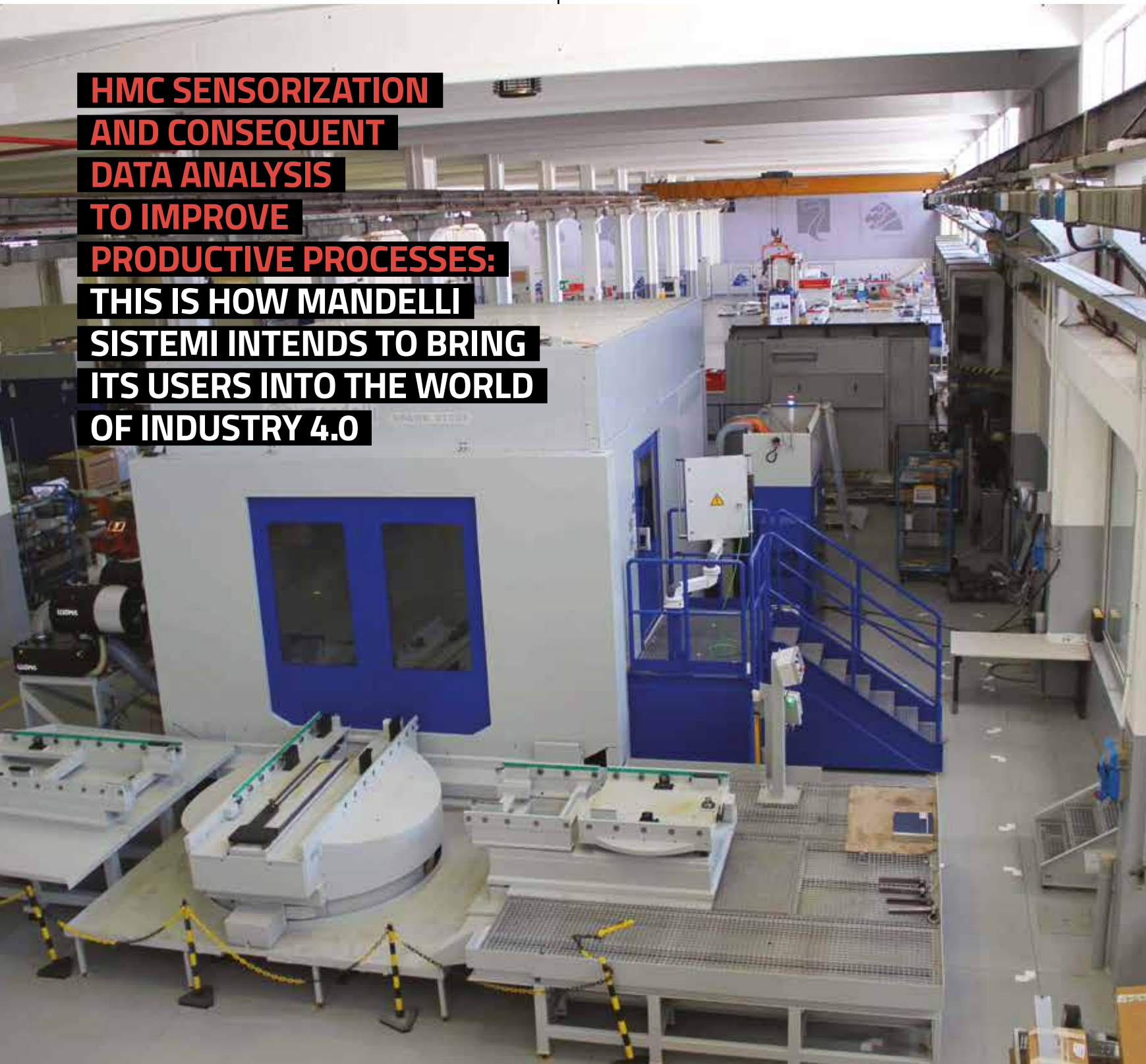




*Mandelli's plant where the tests on the new sensorized machines are carried out*

**HMC SENSORIZATION  
AND CONSEQUENT  
DATA ANALYSIS  
TO IMPROVE  
PRODUCTIVE PROCESSES:  
THIS IS HOW MANDELLI  
SISTEMI INTENDS TO BRING  
ITS USERS INTO THE WORLD  
OF INDUSTRY 4.0**





## [INDUSTRY 4.0]

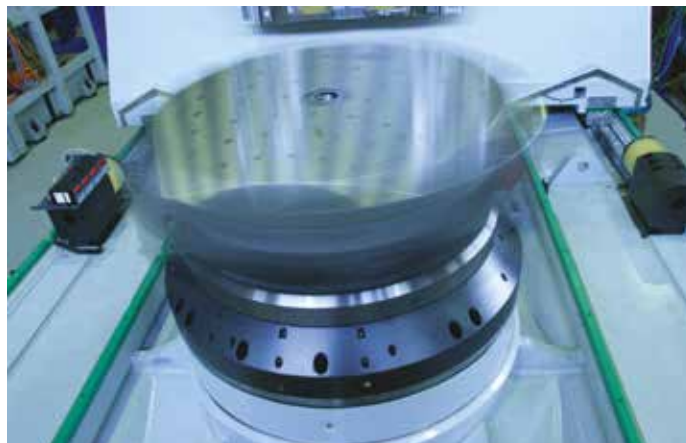
by Andrea Pagani and Flavio Della Muzia

# Communicating Technology

As the Industry 4.0 philosophy teaches, the acquisition of process data generated by an industrial plant has now become a key tool to obtain useful information. And it is in this direction that Mandelli Sistemi has been moving for some time now, supported by its over eighty-year experience in the production of machining centers and industrial automation which has brought the company to face new challenges connected to the designing of plants and machine tools for the near future.

While it is true that sensors on machine tools are certainly not a novelty, it is also true that nowadays the entire manufacturing sector is more and more in need of collecting a large amount of data generated by machining processes so as to use them in a more complex system made of SW and management applications capable of distributing different information to the various company departments to enable technicians, operators and managers to make the most suitable choices at the right time or even make them autonomously to optimize processes.

The increasing HMC sensorization is also possible thanks to the high technological level of commercially available devices, more and more compact and capable of providing efficient remote access to process data also due to the enormous steps taken by the telecommunications and transmission systems that, over the last five years, have experienced a growth higher than many



*Mandelli turning table  
while rotating*

other industrial sectors.

### Information at work

«In our case, the "triggering cause" that started this project was our will to offer an efficient predictive maintenance service to our customers, leading to an enrichment of our HMCs which can provide a series of information functional to an advanced servicing - said Marco Colombi, Mandelli sales Manager. The conceptual core of iPum@Suite 4.0, the new system of products and services proposed by the company which integrates all data collection, process and management operations, was already present at Mandelli a decade ago but the technologies now available to complete it were in fact still missing. For a couple of years now, we have finally been able to give

birth to the work of concepts and analysis previously carried out to develop it with the modern tools we currently have».

In addition to the undeniable benefits of adopting systems that allow the customer to fully manage the workflow, the collection of incoming data from machines is also useful for the HMC manufacturer to assess the real wear to which the HMC components are subjected. All this, of course, without affecting the privacy associated with the customer's manufacturing and production cycle. Mandelli's engineers receive data such as the spindle usage (absorbed power and operation time), axes speed and acceleration values (to evaluate their status, possible collisions etc.) or vibrations (to determine remaining lifespan of wearable parts such as bearings, ball screws etc.).

## COMMUNICATING TECHNOLOGY

Through a sort of check-up, it is possible to determine the HMC "health status" in real time in any operational condition or to have a basic information framework that is very useful to plan future solutions.

«I would like to point out how mature is the machine tool business and therefore all customers are oriented to maximizing the efficiency of their own production while, up to a few years ago, the sensors were applied only by large industrial groups of particular sectors like the automotive -

said Giuseppe Galbiati, Head of Electrical, Electronics and Software Design. The ability to carry out a maintenance intervention only when needed, thus anticipating breakdowns to minimize downtimes, nowadays allows the recovery of 3 to 4% plant efficiency: an apparently limited value but it ensures an interesting increase in market competitiveness».

### Applied Research

«Among the examples that I can mention

to better understand the importance of our choices in terms of intelligent automation, there is an application on one of the vital parts of an HMC that is the electro-spindle: thanks to an important collaboration with KESSLER, a reference partner of ours, we have developed a new generation of electro-spindles in which sensorization plays a primary role compared to previous models - continued Galbiati.

Along with the traditional temperature sensors on all bearings, the head behavior is monitored through the use of vibration sensors (normally there is only one on the spindle in radial direction to monitor any possible collisions), adding accelerometers capable of measuring vibrations in all three directions».

The data generated by these sensors are then processed by one of the iPum@ packages that make up the iPum @ Suite 4.0 offer by Mandelli, namely the iSmartCut package: developed in partnership with MUSP (Acronym for Machine Tools and Production Systems in Piacenza), the application can recognize the anomalies in real-time by monitoring vibrations and then modify processing parameters to stabilize the process. This is an extremely sensitive system capable of analyzing any micro-vibrations that are irrelevant from the point of view of the HMC conditions but sufficient to assess the quality of the workpiece surface and determine whether it will meet the expectations or corrective actions have to be taken to bring the piece to the desired quality standard.

«With the modern numerical controls we use we can, for example, get a wide range of information related to the positioning, speed, axle acceleration and engine temperature which are extremely useful as a starting point for our system - added Galbiati. However, there are other significant data that can be taken from our machines: in fact, we are collaborating with subsystem suppliers such as the aforementioned electro-spindles, ball-screws and roller-slides so as to provide these parts with sensors too. We are carrying out important

## THE HMC DATA COLLECTED ALLOWS MANDELLI TO EVALUATE THE REAL WEAR WHICH SOME PARTS ARE SUBJECT TO



*The turning table with the "bad balance sensor"*



*Mandelli Sistemi can count on over 80 years of experience in HMCs and FMS Systems which have brought it to face new challenges in designing the machinery of the future*

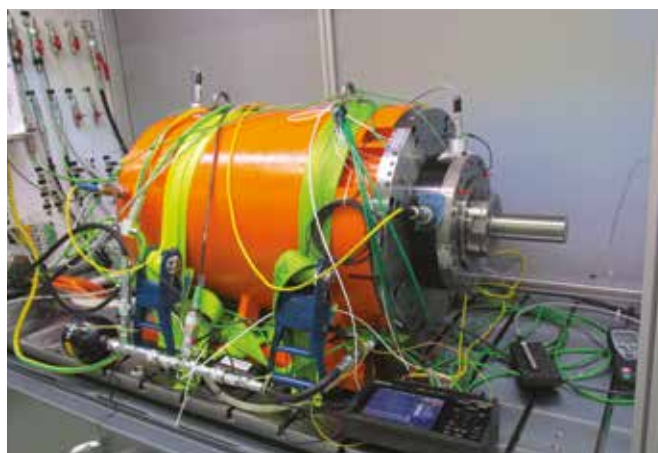
tests on these components, subjecting them to accelerated wear to assess how information from sensors changes in changing the operating life».

Last but not least, it is also interesting to monitor the conditions of the turning tables in Mandelli's multitasking machines to check the workpiece clamping to be correct. This is because the table-tool-piece system can rotate at 600 rpm and beyond: if the assembly is not perfectly balanced there may be consequences first of all on the precision of the machined workpieces and on the life of the bearings and operational safety if the imbalance increases. Along with two different clamping system suppliers Mandelli has also tested the effectiveness of sensors in providing indications on how to balance eccentric loads.

«This allows the customer to evaluate whether the parameters have to be corrected: on the basis of the machining process: in finishing operations the aim remains the highest quality thus justifying a corrective action, while in roughing a slight unbalance may be acceptable, being understood that the operational safety of the plant is to be maintained for values beyond a certain threshold - Colombi emphasized. The interest in these issues is proving to be very high especially by large and structured companies because there is greater and greater awareness and understanding that these tools can improve the efficiency of their production. On the other hand, however, a big obstacle in terms of security had to be overcome about this large amount of data coming from the machines to be treated with all the necessary caution. The fact that plants could be connected into and within a network initially put customers in a state of concern: fortunately today there is much more awareness about data processing and the tangible demonstration of the benefits that such a technology can bring regardless of the size and volumes of work».



Above : a screenshot of iPredict, an iPum@Suite application  
Left : the KESSLER spindle being tested



## MANDELLI HAS TESTED THE SENSORS EFFICACY IN SUPPLYING INFO ON HOW TO BALANCE ECCENTRIC LOADS