



Efficiency to fly

MANDELLI'S LONG LASTING EXPERIENCE IN FMS SYSTEMS FINDS NATURAL APPLICATION IN THE AEROSPACE INDUSTRY WITH THE USE OF MULTITASKING MACHINING CENTERS OF THE SPARK FAMILY. **HERE WE FIND AN INNOVATIVE APPLICATION FOR THE PRODUCTION OF FAN DISKS FOR CIVIL AIRCRAFT.**

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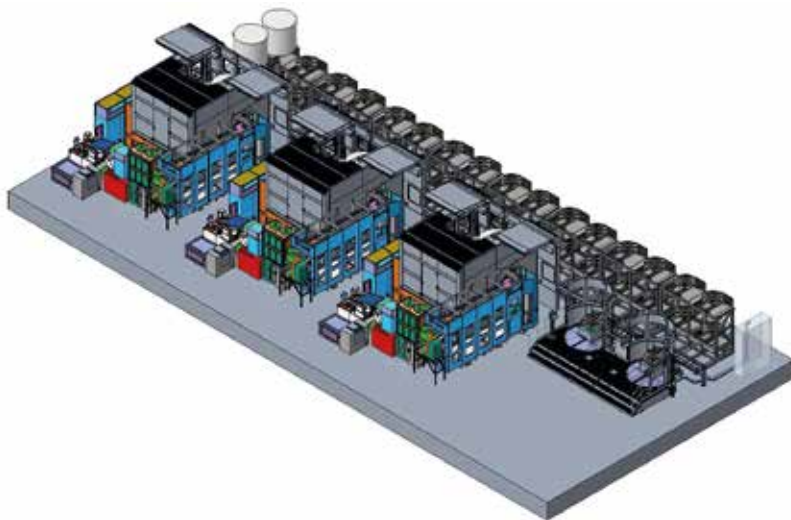
«**T**he aerospace industry – says Marco Colombi, Mandelli Sales Manager, replying to a first question about the market trends - is experiencing an important development phase with a positive outlook and a growth forecast for at least the next 20 years, especially considering the market demand for new aircraft. Two main players share the leadership of this industry and, although one of them is experiencing a stall due to the new certifications necessary for its most prestigious aircraft further to some recent accidents, this phase will surely be overcome by the end of this year. Aerospace industry is therefore going through a development and investment phase which has been experiencing a notable production delocalization in the last years especially towards newly developing countries which are, at the same time, important end markets for aircraft manufacturers. I specifically refer to India, Mexico and some South



The Spark models dedicated to this industry are three: 1600, 2100 and the new 1200 which was recently presented at EMO

East Asia countries where we find some industrial centers of excellence industrially similar to their headquarters, be it European or American». Such a dynamic market scenario pushes the aircraft industry technical and technological evolution as well as the one related to the production systems

for this specific industry. The lower consumption of fuel, which is a major issue for airline companies, and the improvement of the engine yield and aerodynamics seem to be the main R&D levers to invest in the development of ever more performing but difficult to machine materials. As for aerodynamic



WITH SPARK HMCS THE ADDED VALUE IS THE GANTRY STRUCTURE WITH A ROTARY TABLE THAT DOES NOT MOVE ALONG THE LINEAR AXES

Left : layout of the plant made by Mandelli

Right : ATC

and supporting parts, the aerospace industry is heading towards materials that can merge both light weight and tenacity such as carbon fiber which is also used for engines in their cold stages and for casings whereas cobalt and nickel based alloys, such as Inconel, Waspaloy, Hastalloy even more difficult to machine compared to Titanium, are preferred for hot stages. «This technological evolution – adds Colombi – is accompanied by a strongly emerging trend for good organization in production areas : the massive spread of automation. This is the aspect that differentiates the headquarters from the overseas production sites although technologically advanced, a difference which started to spread around 5-6 years ago probably thanks to big Tier1 and Tier2 subcontractors, which show great interest in machining with the

highest efficiency of the production plant».

Mandelli for automation

The trend towards automation did not take Mandelli by surprise thanks to its long and vast experience in automation systems, the well-known FMS, automated cells and isles originally devoted to different applications such as the production of large engines. Mandelli has always been ready to meet the aerospace industry requirements, especially the ones from the civil aircraft industry, now presenting itself as the sole interlocutor for the supply of a plant comprising the production machine, the automation and the SW to be interfaced with the customers' SW managing the production plant. No doubt this is a plus that Mandelli's customers surely appreciate. Technically

speaking, the solutions and expertise available at Mandelli detect two major application fields where to operate with specifically dedicated proposals : engines and structural parts. «The needs of the first applications – says Colombi – have been met by Mandelli with the Spark multitasking HMCs where the added value of our solution is a gantry type HMC architecture with the rotary table that does not move along the axes: this allows for high performances both in turning and milling, merging the benefits of a vertical lathe with the ones of a machining center. The Spark models dedicated to this industry are three : 1600, 2100 and the new 1200 that we will present at the forthcoming EMO, where the number identifies the workpiece maximum diameter. For what concerns structural parts which can be either made of



Titanium alloy, Inconel or HR steel, we have solutions based on the Spark models but specialized in this type of machining, solutions that we call Titanium, to machine tough materials at best starting from the semi-machined raw part. Here the cost/piece ratio is highly influenced by the amount of chips produced; an example of it is Spark 2100 Titanium that we suggest for the machining of landing gears».

Example: the machining of fan disks

It is all about a project that Mandelli has developed for a famous manufacturer of aerospace structural parts such as fan disks that is the front part of the fan on which the turbofan engine external blades are fitted, typical of civil airplanes. It is a highly critical component made of titanium that transfers speed to the blades which,

more and more often, are made of carbon fiber at times added with a titanium core. Before the installation of the Mandelli FMS, this component, made in different versions, was made on four different machining centers: a vertical lathe, an HMC, a special gantry drilling machine and a gear cutting machine. «Our customer – says Colombi – asked us for a more flexible solution even accepting a small reduction in the efficiency on the single machining operations yet improving the entire efficiency of the system to carry out quite a complex cycle. Our solution was an FMS of Spark 1600 HMCs each capable of carrying out the entire cycle. The advantages have proved significant and can be summed up as follows: higher efficiency of the entire plant since a possible stoppage of a single machine does not prevent the others from

The Power Skiving technology has been integrated with Spark 1600 for the machining of toothed gears

working (unlike before when the cycle had to be carried out on more machines); workpiece higher accuracy as it is completely machined on a single unit instead of more; a reduction in the fixtures to be used; a reduction of the workpieces waiting to be loaded onto the machine; a reduction in the number of operators; a reduction of the spares in stock since the machines are all the same type. A series of advantages, with respect to a slightly longer cycle time, guarantee continuity in production, particularly appreciated by our aircraft manufacturing customers». Mandelli cell is composed of 3 HMCs, 2 L/U stations and 40 pallet tables and, according to the customer's needs, could be expanded up to 5 HMCs, making it also possible to have an additional twin cell, besides possible implementations in terms of automation such as the centralized handling of tools and the workpiece L/U robot cell. «The three Spark 1600 multitasking HMCs – adds Colombi – feature a max payload on the RT of 2.500 kg, high

➤ FOR THE MACHINING OF TITANIUM ALLOY, INCONEL OR STEEL STRUCTURAL PARTS MANDELLI PROPOSES A SOLUTION WHICH IS A TITANIUM EVOLUTION

torque electro-spindles, 700 Nm at 8.000 rpm, 200-pocket TM for each HMC and two tool tapers, one fixed for turning and the other for milling. The plus aspects of this solution are many. For example, we have adopted a 350 bar coolant system in turning to carry out turning operations without the presence of the operator: actually, the materials being machined produce long chips that doesn't suit the needs listed above; hence the extremely high pressure of the lubricant guarantees the chip to get duly broken thus doubling the cutting speed. Starting from the raw piece, the challenge was to reduce the cycle times while milling the blade housing slots; we made it with a single special tool, a 150 l/min coolant flow and the vibration damping systems patented by Mandelli. The other technology integrated in our Spark 1600 refers to the Power Skiving machining of toothing on which we have reached excellent results: we have carried out tests on a 0,1 inch module getting to a DIN5 class accuracy that is the one attributed to ground gears». Last but not least, the FMS management is controlled by Mandelli Supervisor, iPuma Scada, which is part of the iPum@suite4.0 to manage the production and interface with the customer's SW to exchange data. iPum@suite4.0 enables the customer to control different functions and SW conditions according to the Industry 4.0 paradigms: predictive maintenance, automatic vibration damping, Augmented Reality to make maintenance easier, latest generation

*Turning machining
with 350 bar pressure
lubricant*

man/machine interface and integration between FMS and the customer's SW. These are the five pillars of Mandelli digital revolution. «This cell – ends Colombi – is configured to work 24/7. Throughout the guarantee, we have forecast the presence of a Mandelli technician to guarantee maximum efficiency in production and allow our customer to master the system which represents a real technological leap». ■



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