



**LAUNCHED THE AMBITIOUS
SPARK-4.0-I.E.S. PROJECT
BY MANDELLI SISTEMI
FOR THE STUDY AND DEVELOPMENT
OF A HIGH PERFORMANCE
HYBRID AND SMART
PRODUCTION SYSTEM
TO WORK HIGH-TENACITY MATERIALS
IN AERONAUTICAL APPLICATIONS.**

[RESEARCH & DEVELOPMENT]

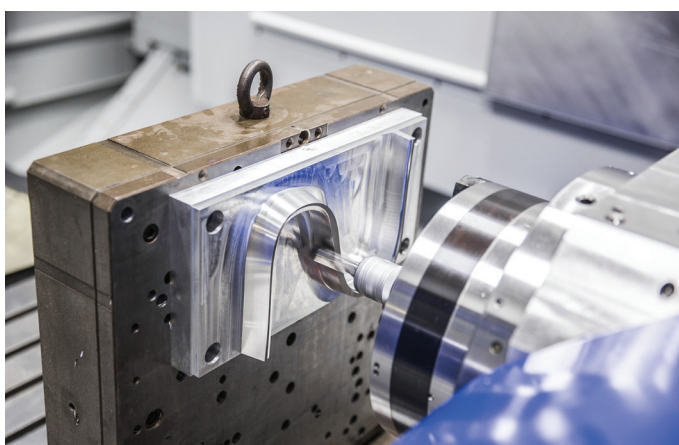
by editorial staff

Hi-tech

for titanium and Hrsa alloys

Mandelli Sistemi, with a history of over 80 years dedicated to the production of horizontal 4 and 5 axis machining centers and flexible FMS systems characterized by a strong content of technological innovation, is among the leading companies in the aviation industry. An international role that has been consolidated in recent years thanks to a forward-looking investment policy in resources, both instrumental and human, with special attention to the Aerospace application industry which today generates about 60% of the turnover.

In this strategy towards growth a decisive contribution is provided by the R&D activities that are carried out at Mandelli and produce technological innovations aimed at obtaining the maximum performance of their machines. It is just the Research & Development the protagonist in the recent strategic project launched by the company and partially funded by the Ministry of Economic Development as part of the "Fund for Sustainable Growth". This international project has a duration of 3 years and is spread over 8 OR (realizable objectives) within which some sub-activities are forecast to be realized both by using the high internal company skills and by collaborating with selected consultants and external designers.



The S-Shape test, from the aerospace industry, has now become standard for testing 5-axis HMCs

Sp@rk-4.0-I.E.S. (Interconnected, Efficient, Sustainable)

The project intends to develop an innovative technology in the industry of production systems for the processing of high-performance tough materials such as titanium alloys and nickel-based super alloys. The main objectives of the project are related to the increase of productivity through a higher production efficiency aimed at reducing the costs of processing and machine management. In this sense, the realization objectives also include the development of advanced digital systems for self-diagnostics and machine network interconnection in order to ensure the machine optimal use and maintenance. Last but not

least, the high sensorisation and the self-regulating systems ensure the optimization of consumption and general functioning of the production system.

«The recent market analyses - explains Marco Colombi, Sales Manager at Mandelli Sistemi - have highlighted a growing attention of our customers towards materials hard to machine such as titanium for the machining of motor and structural components for the aeronautical industry, for example parts of the landing gears or wing-fuselage connections.

To maintain its leading status Mandelli has decided to increase the technological performance as well as the level of reliability of its machines

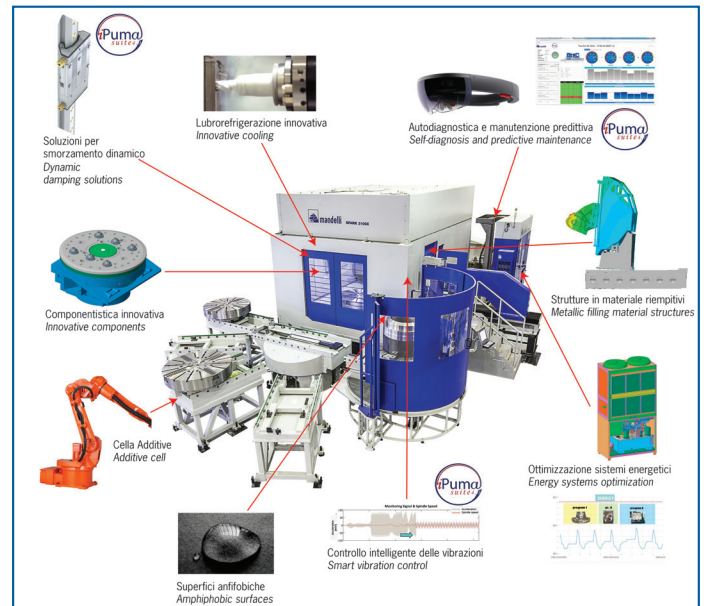
HI-TECH PER TITANIO E HRSA

to better respond to the needs arising from the production of aeronautical components, such as structural ones, for which it is essential to reduce the vibrations that tend to trigger during the cutting process. This means increasing the removal capacity, in terms of Material Removal Rate (MRR), while maintaining the surface finishing levels required for the functional application of the component. Moreover, the possibility of performing roughing and finishing operations on the same machine has great advantages because it allows for the reduction of the number of setups, reducing semi-finished products (WIP) and allowing for slender and efficient processing flows. In addition, what the Customer requires - continues Marco Colombi - is to have a production system able to maximize performance, energy and process efficiency, which allows for the reduction of the Total Life Cycle Cost».

Technological context of the aeronautical industry

The civil aviation market is experiencing a growing phase and the forecast for a positive outlook extends over the next twenty years: the main manufacturers agree on an estimate of over 33 thousand new aircraft by

Sp@rk-4.0-I.E.S. (Interconnected, Efficient, Sustainable) intends to develop an innovative technology within the production systems dedicated to the machining of high performance hard materials and nickel-based superalloys

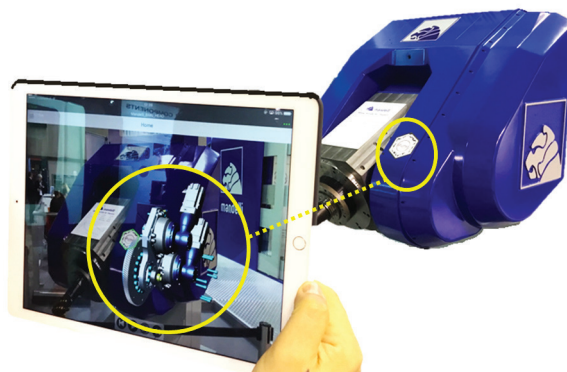


2035, 40% of which destined to the replacement market. The main technical / technological evolution is the reduction of consumption driven by the fact that fuel is the highest cost for an airline; also the improvement of the performance of engines and aerodynamics has a green effect as it implies a reduction of harmful emissions. The technical guidelines for the reduction of emissions are mainly three: new wing profiles with high aerodynamic efficiency, new generation of "fuel efficient" engines and weight reduction of aircraft. The second and third directives have an important impact on the metal removal processes pushing research towards increasingly performing materials consequently, more difficult to machine. Ever lighter

materials are adopted for structural aerodynamic parts where an evolution from aluminium to materials based on carbon fibre (CFRP) is observed, and for the load bearing parts, such as the chassis and the landing gears: for the latter the choice is increasingly directed to titanium alloys, materials that have a very favourable resistance / mass ratio almost double compared to steel thus able to combine lightness and toughness. A similar evolution is underway in the development of engines where, for the first cold stages and for the casings, the adoption of carbon fibre is starting, while in the hottest stages the basic alloys of cobalt and nickel prevail, such as Inconel, Waspaloy, Hastelloy. These alloys have characteristics of resistance at very high temperatures and are therefore even more difficult to machine than titanium as they tend to reject the heat generated in the cutting area thus increasing the wear of the cutting parts.

Right : the evolution of iReality, one of the targets which will be attained with the development of the project

Below: The partner in the MiSe Sp@rk-4.0-I.E.S. (Interconnected, Efficient, Sustainable)

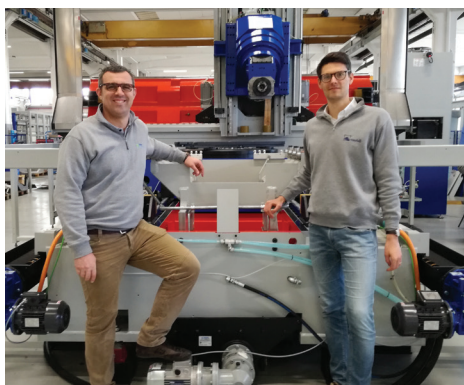


PARTNERS:



Mandelli's product strategy

«In this panorama of increasingly performing and difficult to process alloys - adds Riccardo Daverio, Project Manager of MiSe Project - Mandelli intends to propose a new solution with the aim of obtaining a substantial improvement, not only marginal, of the machine performance that, since the beginning, has been studied to machine these materials. The adoption, also in the



*Right : Marco Colombi, Sales Manager
and Riccardo Daverio, Project Manager of
Mandelli's MiSE Project*

Left : Mandelli's HMC model Spark 2100X

aeronautical industry, of lean methodologies for the reduction of waste in production has led to a general review of production flows trying, where possible, to reduce the number of setups in order to diminish the work-in process».

In order to facilitate the reduction of the WIP and thus contribute to the implementation of "One Piece Flow" logics, the new Mandelli machining center has the operational objective of combining power / rigidity (which can be summarized in POWER, the first of the four values that Mandelli offers as differential elements with respect to the other "contenders" operating in the industry), necessary for the roughing operations, with precision / speed (which can be translated into AGILITY, the second of the four Mandelli Values), required by the finishing, making it possible to execute milling, drilling, boring and turning with a single machine (which can be defined as VERSATILITY, the third characteristic value of the Mandelli solutions). What above is achieved through the integration of cutting-edge technologies for the processing of tough alloys such as active vibration damping, cryogenic fluids for milling, very high refrigerant pressure (UHPC) in turning. Particular attention is then also placed in the recent innovations in the field of additive technologies which could offer further advantages.

«In aeronautics - says Marco Colombi - additive technologies are being progressively and increasingly applied thanks to the characteristics of being fully responsive to the primary need of weight reduction as particular geometries can achieved which could

not be only by removal, geometries even more performing further to their capacity to withstand mechanical stress per unit weight. With these technologies we produce raw parts that need finishing on the machine tool and therefore an important advantage in terms of productivity and efficiency can be achieved by combining additive machining to a machine tool. This way an integrated production system is created which carries out the entire cycle, from the raw to the finished part. There is also an aspect, let's say, system-based that we have considered: aerospace companies are normally important groups, often multinationals with several production plants sometimes located in different continents, which need to collect and coordinate a large number of data from plants far from each other even several thousand kilometres. Mandelli has seized this pressing need of the market through the innovative product i-Pum@suite4.0 consisting of the enrichment of the machine sensors aimed at collecting the operating data of all the important and / or subject to wear components and the equipment of real-time data transmission tools so that they can be remotely shared and monitored telemetrically. These tools, besides maximizing the efficiency of the individual production, mean reducing downtime thanks to predictive maintenance and augmented reality strategies (concepts that can be summarized in ENDURANCE, the fourth of the values that Mandelli offers as differential elements), they will make possible an increasing knowledge of how the machine can be optimally used ensuring the simultaneous central

management of production systems, represented by a multiplicity of machining centers. We are therefore facing a decisive step in the direction of the Smart Factory: a step of strategic importance, not only for Mandelli, but for the national manufacturing industry considering the technological value and the different research and development issues that this project deals with».

The innovative proposal by Mandelli Sistemi

From all these technological and market considerations the project Sp@rk-4.0-IES by Mandelli Sistemi springs up picturing the development of a production system configured in its main elements as follows: a control platform that, through strategies of variation of the spindle / table rotation speed, breaks down the chatter vibration phenomenon; high torque turning fixed table together with a spindle installed on the movable Y axis; active vibration damping systems acting on linear and rotating axes, according to automatic strategies activated in real time based on the vibrations detected; machine structures designed by integrating the traditional construction methodologies with the appropriate and effective use of damping materials; very high pressure cooling system (UHPC> 250 bar) for turning operations in order to fragment chip, hydrophobic amphi-phobic water repellent materials to facilitate the evacuation of the lubricant and chip; lubricant cooling system with cryogenic fluid to improve tool performance; integration of additive technologies; advanced and smart monitoring system for the machine and its individual components; predictive maintenance system based on Big Data-Analytics techniques, on cloud platform, in order to forecast the residual life of the monitored components; interactive maintenance systems using Augmented Reality tools; high efficiency units and self-regulating systems to promote the machine sustainability and energy efficiency. ■