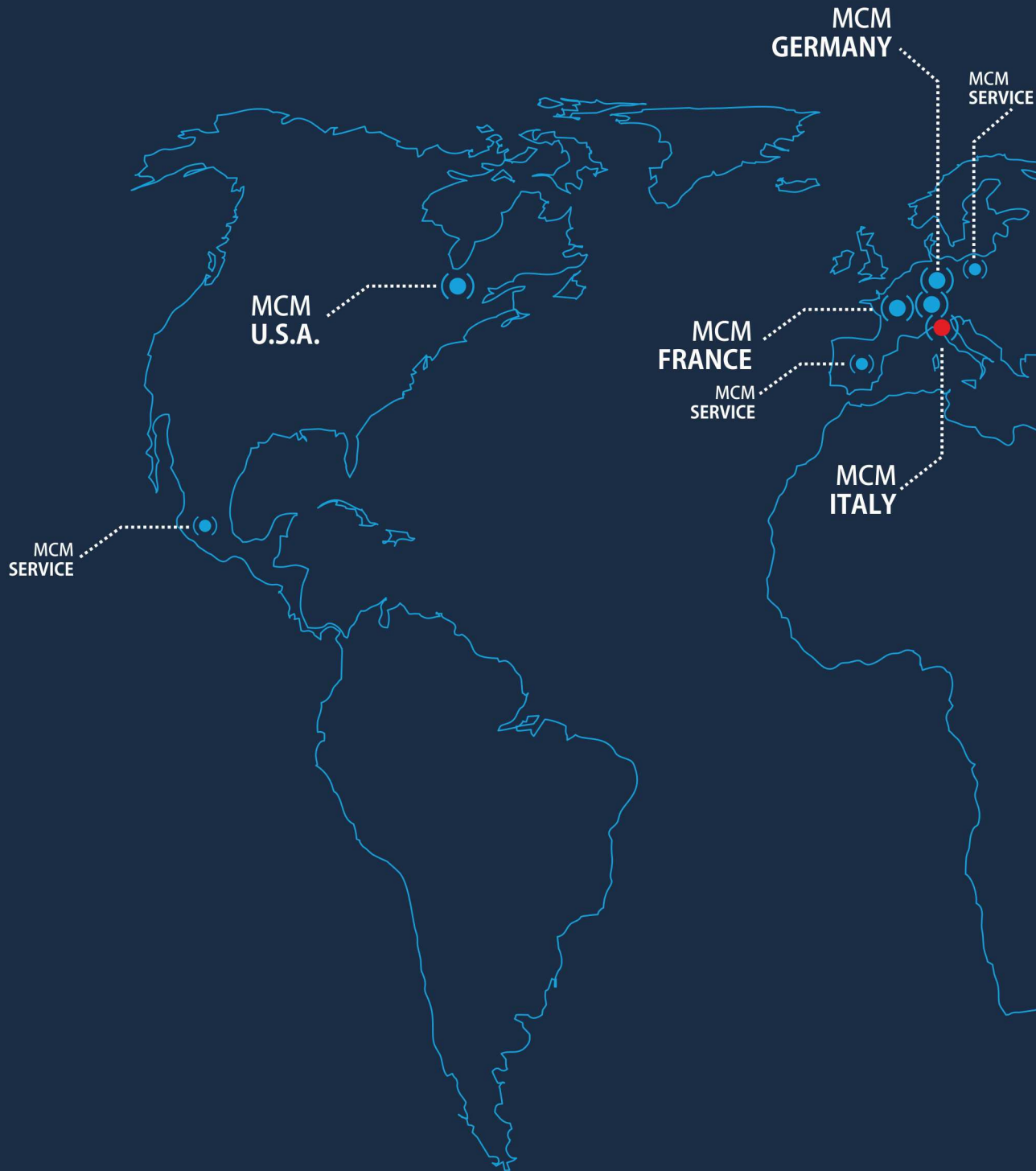


AERO GEARBOX INTERNATIONAL

High-performance Machining Centres and
Process Technologies for the production of
transmission gearboxes for aircrafts

CASE HISTORY #06





AEROSPACE



AUTOMOTIVE



INDUSTRIAL



ENERGY
OIL & GAS



MACCHINE
ATTREZZATURE
E DIFESA



COMPONENTISTICA
INDUSTRIALE

AERO GEARBOX INTERNATIONAL

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MCM is a specialist in the design and production of flexible manufacturing systems. The core of them are 4 and 5-axis horizontal machining centres, characterized by technical solutions to achieve maximum performance with no compromises. In addition to the units manufactured in-house, MCM is also able to incorporate, into the production lines,

machines featuring complementary technologies. This allows the engineering of complete and customized solutions, giving customers the benefit of a single, competent and reliable partner. MCM's product range includes machining centres, flexible automation solutions, systems integration, management software and process technologies.

Customer

Aero Gearbox International is a joint venture established in 2015 by Safran Transmission System and Rolls Royce. This new company is present in France, Germany, UK and Poland for manufacturing. In Poland, end of 2016, Aero Gearbox International started its activities in Ropczyce, in the southeast of the country. It is in this plant that the partnership with MCM proves its effectiveness and supports the production of 'Accessory Drive Trains', the core business of Aero Gearbox International. These are transmission systems for civil aircraft engines consisting of a large aluminium alloy gearbox in which a system of gears and shafts, highly stressed under operating conditions, are housed. The function is to power a number of

essential services within the aircrafts: pilot systems, fuel pumps, hydraulic pumps, lubrication systems, starting systems, electric generators that power additional systems (such as air conditioning or entertainment in the aircrafts). The Accessory Drive Trains are very complex gearboxes to manufacture, due both to their geometry and to the extremely limited orientation and position tolerances, especially when compared to the overall dimensions. Aero Gearbox International is one of the world's leading companies in the production of these types of components, also thanks to the MCM machining centres, thus covering the supply of new-generation Rolls-Royce engines.



THE TECHNOLOGICAL CHALLENGE

At the Ropczyce plant, Areo Gearbox International has decided to put into production two new models of Accessory Drive Trains - Transmission System. As almost always happens, MCM has been involved starting from the definition phase of the plant. The request included not only the supply of complete plants ready for operation, but also the development of an innovative and suitable process technology solution (part program, fixtures, tools, etc.) for the production of the aluminium alloy gearbox.

For the production of this type of components, the starting blanks are generally made up of forging blanks that already have hollows and holes inside them, which are then finished through machining operations. However, Areo Gearbox International has revolutionised this 'traditional' approach, using a massive forged component, free of internal holes and hollows, as starting blank. Therefore, all emptying operations are carried out directly inside the machining centre by means of chip removal. This new approach eliminates the risks of irregular or non-compliant forging

blanks and, in particular, drastically reduces the costs, while also offering total manufacturing flexibility (since it is independent of foundry models). On the other hand, this results in an exceptional technological challenge for the definition of the machining cycle: many operations have to be performed, the workpiece remains in the machine for hours, potentially with significant thermal transients, and the risks of tool breakage and generation of scrap parts have to be eliminated. The sequence of removal operations and the thrusts on the workpiece generated by them must also be adequately foreseen (and compensated, if required) in order to avoid deformation and spring back of the workpiece that may compromise its precision.

Therefore, the production of gearboxes for these newly developed Accessory Drive Trains has both the well-known need of high-quality and high-performance machines and the formulation of an in-depth process technology analysis that only a company with high technical knowledge and practical experience such as MCM is able to provide.



MCM's SOLUTION

MCM has a Technology Engineering department experienced in the development of tailor-made machining solutions for complex parts and for the optimisation of production processes. FMECA, Process Design for Capability, use of CAD / CAM technologies are examples of the activities carried out by this department. The team has been involved in the detailed design of the production cycles and in the prototyping and final validation. Areo Gearbox International (Polish facilities) is already using these competences, through four Tank 5-axis machining centers already installed for the machining of gearbox and completion elements. The production of the machined parts requires very high precisions with low tolerances for the complete machining from A to Z. All machining operations must be carried out in a single cycle lasting several hours, without transfer to other machines and with an extensive use of tools with different geometry and dynamic characteristics. The need to reposition the component on the fixtures, within the same machining area, has imposed an accurate refinement of the machining strategies to reduce cycle times as much as possible while ensuring the highest quality and compliance with very limited tolerances.

THE CHOICE OF THE MACHINE

Generally, the parts of this type of gearboxes are machined with MCM 4-axis machines. The choice of the 5-axis Tank 1900, with tilting head, is the result of a careful technological assessment carried out by MCM, functional to the supply of a single machine able to perform all the necessary processing, obtaining the transmission gearboxes in a single cycle, with

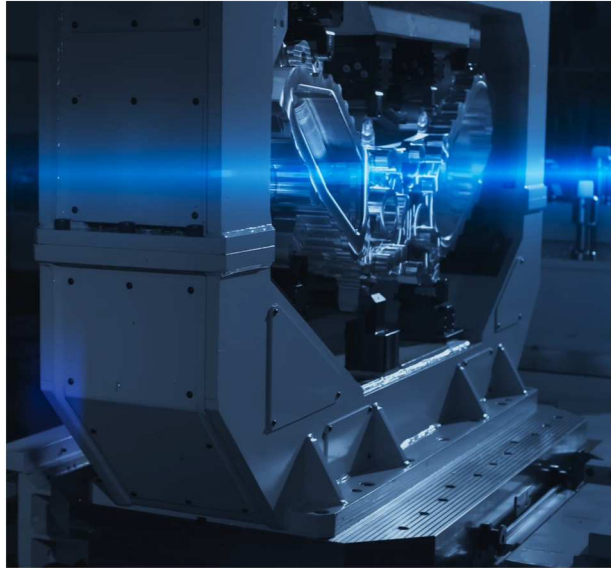
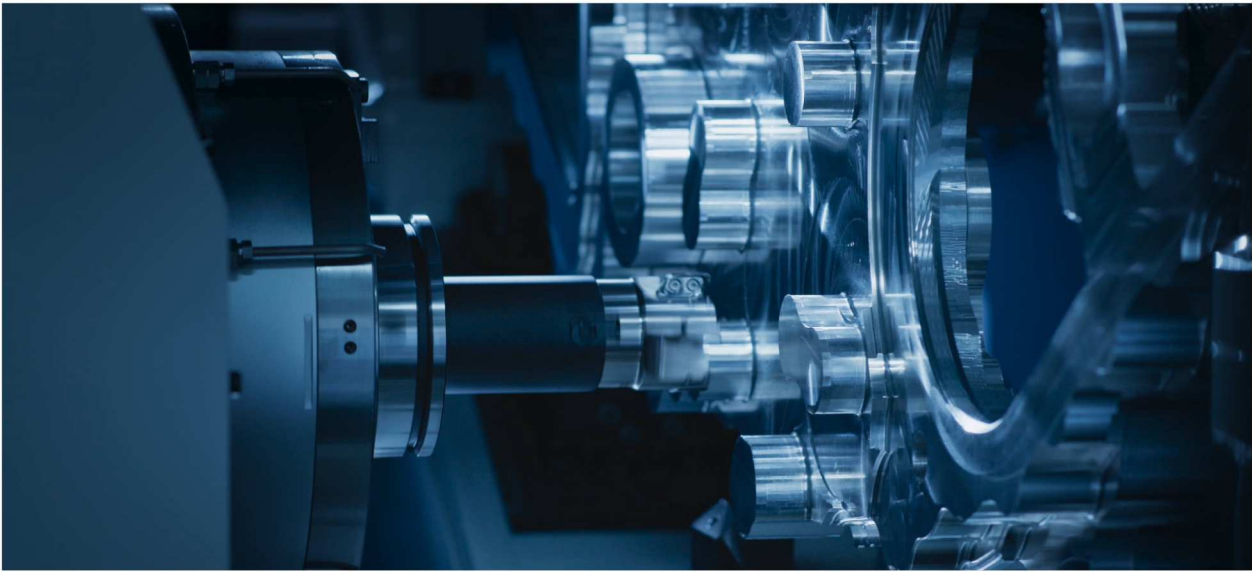
clear benefits for the customer in terms of precision and time reduction. The high machining precision obtained with the Tank 1900, a medium-large machine with considerable structural rigidity, is the result of great attention to all construction aspects, to the geometric precision of the machine, to the thermo-mechanical symmetry and to the excellent components used.

The project that led MCM to deliver the complete plant began in 2017 and ended in March 2019, with the installation of the machines equipped with the jFMX platform, the exclusive MCM software and all manufacturing process plan.

THE PROCESS TECHNOLOGY

The process technology study followed the classic pattern of technological investigation of applied research. This was structured on the alternation of modelling phases and software simulation, validated through preliminary operational tests increasingly complete and detailed.

The solution provided to Areo Gearbox International allows continuous production in several phases in which the component is repositioned on the fixture several times. The process developed by MCM engineers, with Aero Gearbox International support and validation, for the complete machining of workpieces from forged blanks as casting, has allowed the full respect of the required tolerances, with great satisfaction of Areo Gearbox International. Also in this project, MCM has confirmed itself as a high-profile technological partner for the implementation of innovative and challenging production strategies and high-performance machining centres able to support them.





TECHNICAL FEATURES

Machining area

Tank 5AX_1900

X axis	1,900
Y axis	1,400
Z axis	1,960
X/Y/Z axis thrust	2,000 daN
(Rapid) feed rates	32 m/min
X/Y/Z axis acceleration	5.5 M m/s ²

Linear axis precision

Positioning accuracy (A)	5 µm
Positioning average deviation (M)	3 µm
Unidirectional repeatability (R)	4 µm

Rotary axis precision

Positioning accuracy (A)	4 arcsec
Positioning average deviation (M)	2 arcsec
Unidirectional repeatability (R)	3 arcsec

Spindle

Nose	HSK 100
Speed	18,000 RPM
Maximum power	95 kW
Maximum torque	305.4 Nm

Tool magazine

Type	Modular rack with tool handling system and exchange arm
Tool nose type	HSK 100
Number of tools	399
Tool mass	25 kg
Maximum length	600 mm
Maximum diameter	325 mm

Rotary Table

Maximum rotation speed	20 RPM
Maximum permitted load on pallet	2,500 kg
Continuous Torque	2,200 Nm
Clamping Torque	6,500 Nm

Tilting head unit (screw - crown)

Maximum rotation speed	15 RPM
A axis tilting angle (standard)	175 degrees (+70/-105)
Torque in Contouring	3,600 Nm
Clamping Torque	8,740 Nm

MCM

HEADQUARTERS

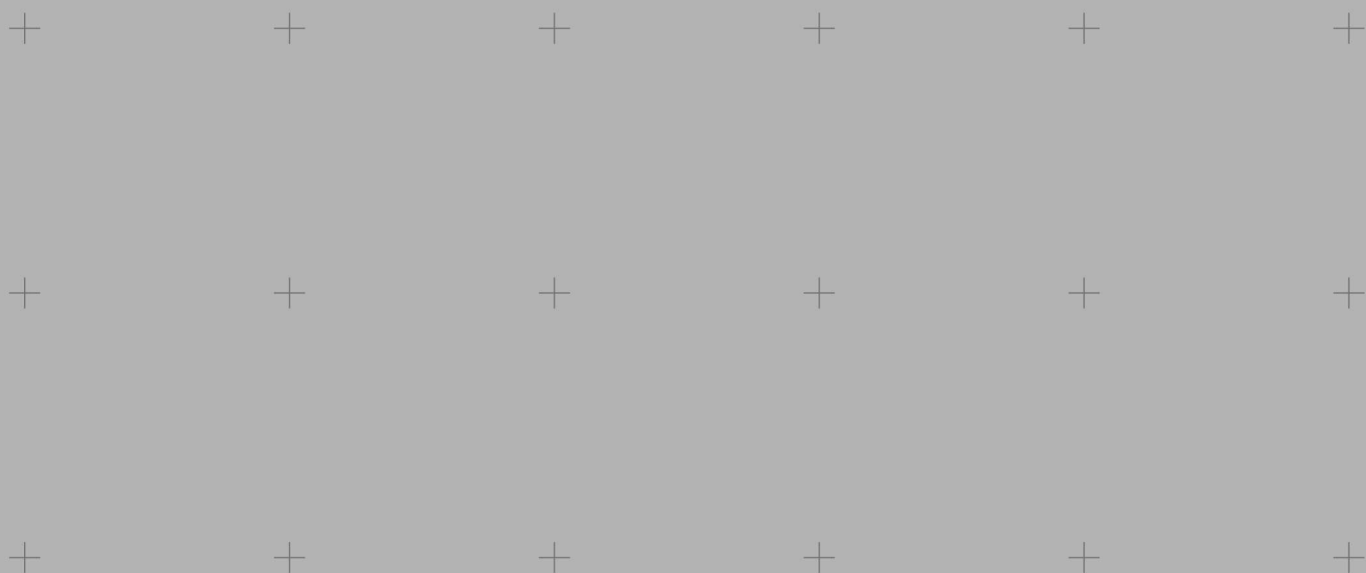
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BRANCH OFFICES

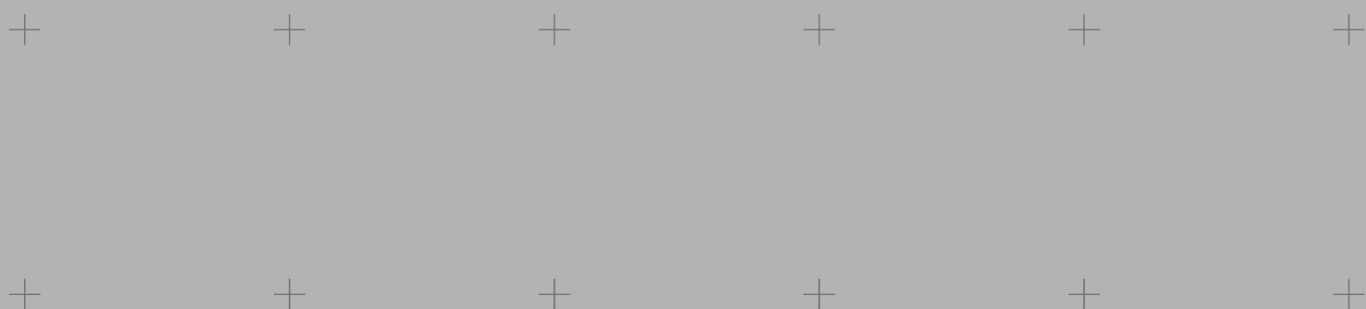
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