

PAPER

Technological innovations aimed lessening environmental impacts in the aeronautical sector

The targets set by the European Union in terms of sustainability and mobility have made it necessary to renovate fleets and use new manufacturing systems to satisfy current demand levels.

Author: Oscar Gonzalo, head of the Aeronautics Sector at Tekniker

Transcendental shifts are currently taking place with regard to how we should address the climate change challenge from a social, economic and environmental perspective. As regards the aeronautical sector, the goals set by the European Union with regard to the level of climate neutrality to be achieved by 2050 require more investments in technological research and the implementation of innovative solutions to transform aeronautics. The ultimate goal is to reduce CO2 emissions by 30 to 50% and improve the mobility for passengers and cargo.

Sustainability: towards climate neutrality

The main lines of research aimed at improving sustainability in the aeronautical sector are currently focused on reducing emissions by developing new **propulsion systems** that use energy sources such as electricity, hydrogen or SAF (Sustainable Aviation Fuel). **Lighter designs** are also being looked into to produce structural components and more efficient designs for aerodynamic components.

When both aspects are brought together it becomes possible to develop **new architectures for aircraft** that can accommodate new energy propulsion and storage systems.

Current trends aimed at electrifying and digitising the sector have also posed new challenges in terms of actuation and control systems.

This new generation of aircraft will require new designs to incorporate all of these new technologies and achieve sustainable transport.

New mobility trends

According to forecasts released by leading aeronautical manufacturing companies, there will be a significant **increase in air traffic** over the next decades that will double the figures reported prior to the pandemic by the year 2041 with a significant renovation of aircraft. The number of planes carrying more than 100 passengers is expected to double.

Most studies point out that there will be **more types of new aircraft** available to meet mobility demands as a function of whatever has to be carried (passengers, goods, unmanned aircraft, etc.).

It has therefore been estimated that electric propulsion will be used more for short flights, urban mobility and certain types of aircraft such as helicopters. As far as hydrogen is concerned, it is expected that the range will be extended to medium and short distance flights. Long-distance flights, however, will still be covered by planes propelled by ultra-efficient turbine technologies using fuels and SAF or hybrid technologies to make the most of the different alternatives (electricity, hydrogen and SAF) that are currently available.

Industrialising all the progress made to date

In order to meet all of these technological demands, it will be necessary to develop suitable production systems so that all the progress made to date can be industrialised based on sustainable and efficient manufacturing practices adapted to rates of production required to meet future demand.

Any actions focused on digitising these design and production processes will also be relevant in terms of addressing a product's complete life cycle and eventual recycling.

It is in this context that Tekniker, the Basque technology centre, is working to develop solutions aimed at achieving this sector's objectives. Although the organisation's main focus is to improve the sustainability and efficiency of manufacturing processes in which components are involved, another of its goals consists in directly helping to improve the sustainability and mobility of air transport by applying in-use design and control of aircraft components.

The following chart shows Tekniker's contributions towards the sector and their scope in all three phases: design, manufacture and use.

 <p>● DESIGN</p> <p>● MANUFACTURING</p> <p>● USE</p>	Improving materials - FEATURES	●	●	●
	Improving processes - EFFICIENCY		●	
	Improving resources - PRODUCTIVITY	●	●	●
	Inspection and measurement - QUALITY CONTROL		●	
	Digitisation and MRO - OPERABILITY		●	●
	Design and electrification	●		

Tekniker and its contribution in terms of features and productivity

As regards **component manufacturing practices**, Tekniker is looking into how to improve and upgrade manufacturing resources, processes and materials and is also considering other technologies used to inspect and measure components, digitise production as well as maintenance actions for production equipment.

In terms of **materials**, surface modification processes have been addressed to incorporate additional functional properties (anti-icing, anti-adherence, cleansing...) to the components produced by using coating and texturing techniques. The technology centre is also working on additivation applied to polymeric materials to achieve the same objective.

Tekniker is also developing recycling and reutilisation technologies for composites to extend the operating life of fibre carbon materials (prepreg uncured and thermoplastic composites).

Manufacturing processes are mainly related to stock removal and laser techniques. As regards the latter, Tekniker performs processes related to additive manufacturing, drilling, surface hardening and welding. As regards machining, processes are optimised by analysing cutting conditions, designing tools and using assisted machining technologies.

The centre has also addressed the optimisation, design, manufacture and assembly of production resources including machines with their fittings, test benches and robotic systems specifically geared towards developing standalone and collaborative systems.

Inspection and measurement | Digitisation

Tekniker is able to provide a number of supplementary technologies that can be used whilst manufacturing aeronautical components or even when they are in-use.

Inspection and measurement encompass the metrology technologies used for quality control and to improve manufacturing processes, their resources and end products. They are sometimes applied to check components when in-use. Tekniker has developed measuring methods and equipment to carry out these processes quicker and with a higher degree of accuracy. More specifically, the centre incorporates metrology systems to production resources.

The ultimate goal of the **Digitisation** actions currently underway at the technology centre is to obtain data which, once analysed, will allow conclusions to be drawn with regard to how to optimise production processes and resources or components already being used aboard aircraft.

The purpose of these analyses is to improve the design and operation of systems and to implement optimum maintenance strategies. In order to do so, data is gathered by sensors or digital twins whenever direct measuring actions are impossible.

Certain applications used in the aeronautical sector can analyse the condition of different components (actuators, fluids, gaskets...) on test benches to establish maintenance strategies.

Finally, and as regards **designing aircraft components**, Tekniker's activities are focused on introducing electrical systems to further the electrification of planes by means of power converters and electric actuators.

The technology centre has applied its extensive range of technological products to a number of initiatives funded by the European Commission such as INNOTOOL, RECYCOMP, WEIBAL or FLUIDER as a support for leading aeronautical manufacturers, to improve their production processes and products and eventually develop manufacturing and aeronautical industries that are much more sustainable and efficient according to the requirements of the new EU mobility paradigm.

Tekniker's contribution has mainly focused on developing production processes that are more sustainable and that can reduce the environmental impacts that will be arise over the next few

years as a consequence of a growing demand focused on building aircraft required to replace the current planes. The end result of this will be significantly larger fleets. The organisation is also collaborating with aircraft and system manufacturers to develop new concepts whose ultimate goal is to improve sustainability and mobility in this sector so that climate neutrality can be achieved by 2050.