![IDEKO - MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE]

INFORMATION DOSSIER – BIEMH 2024

# Cutting-Edge Robotic Technologies for the aerospace sector, the main innovation from IDEKO at BIEMH

- *The research center will showcase an award-winning robotic cell with unique capabilities for machining of composite parts with high precision without leaving hazardous dust generated during the process.*
- *At the international fair, it will also exhibit capabilities in texturing and surface topography characterization, solutions to improve the dynamic behavior of slender parts, and new applications of Artificial Intelligence in manufacturing.*
- *Additionally, at its stand E15 in Hall 1, IDEKO will host workshops on new digital tools aimed at optimizing equipment maintenance and improving productivity.*
- *The 32nd Machine Tool Biennial will be held at the BEC in Barakaldo from June 3 to 7.*

Technological advances in robotics, digitalization, and automation of industrial equipment and processes are paving the way toward smarter, more efficient, and more sustainable advanced manufacturing. R&D plays a decisive role in this transformation by transferring knowledge and innovative solutions to the industry, optimizing and improving processes, reducing costs, and increasing productivity, competitiveness, and sustainability through the development of cutting-edge technologies.

IDEKO, a member of the Basque Research & Technology Alliance (BRTA), is one of the main drivers in R&D applied to industrial manufacturing. At the 32nd edition of the Machine Tool Biennial (32BIEMH), it will once again demonstrate this with solutions showcasing the capabilities of its four research groups: design and precision engineering, manufacturing processes, dynamics and control, and ICTs and Automation.

From innovative robotic cells designed for high-precision, safe, and clean machining of composite parts to advanced applications of Artificial Intelligence in manufacturing processes, as well as expertise in surface texturing and vibration elimination, IDEKO demonstrates a strong commitment to enhancing the sustainability of the sector. These solutions help reduce waste, minimize machine disturbances (errors and breakdowns), and decrease operator disturbances (noise) during production processes, while also boosting the energy efficiency of machines. IDEKO's demonstrators will be showcased at stand E15 in Hall 1 of the Bilbao Exhibition Centre (BEC).

### 1. Robotic cell for clean, safe and high precision machining of composites

IDEKO's approach to robotics is based on giving commercial robots unique capabilities to perform tasks with high precision that a standard robot cannot achieve. The technology center accomplishes this through its specialization, combining knowledge acquired by its different research groups: design and precision engineering, manufacturing processes, dynamics and control, and ICTs and Automation.

An example of this work can be seen in IDEKO's main demonstrator at the new edition of BIEMH: a robotic solution developed within the framework of the European project FIBREMACH, which integrates the knowledge of its four research groups and allows the precise, efficient, and clean machining of carbon fiber or glass fiber parts.

To achieve this, IDEKO, which has extensive knowledge and expertise in these machining processes, has developed an artificial vision system that increases the robot's precision using various cameras and self-developed photogrammetric algorithms. The cameras track and monitor the robot's position in 6 degrees of freedom (DOF) in real-time by tracking the head and sending the robot the compensations indicated by the multi-camera system to perform the trajectory more precisely and operate more intelligently. Thanks to this system, the robot continuously and at high speed corrects its position and orientation based on the measurements of the cameras and can machine with a precision of between 0.1 and 0.2 millimeters throughout the robot's working area, improving the robot's precision by a factor of four times compared to its original capability.

This capability positions the robotic cell as a more flexible and reconfigurable alternative for machining composite parts, which are traditionally machined with more complex machine tools. Additionally, IDEKO's dynamics and control team has implemented an automatic chatter detector to identify potential problems and automatically adjust the spindle rotation to eliminate vibrations during machining.

The robot is equipped with integrated sensors that measure and analyze vibrations generated during machining. If excessive vibrations are detected, which can result from poorly clamped fixtures or worn tools, the robot automatically adjusts its operating parameters to reduce vibrations and prevent part damage. Additionally, a cloud-based monitoring system with machine learning analytical functions has been incorporated for automatic process and robot supervision. This system provides operators with all the measured data for subsequent analysis and visualization, enabling timely preventive decisions regarding both maintenance and operation.

**Internal dust suction technology**

The cell includes a patented technology by IDEKO integrated into the head that sucks up 100% of the dust generated during these machining processes. This process is especially critical because, during cutting and drilling operations of carbon fiber or glass composite material parts, a large amount of hazardous dust particles are generated that are harmful to health, potentially causing respiratory difficulties, dermatitis, conjunctivitis, and some chemical components are even classified as potentially carcinogenic. This

dust is also harmful to the life of the machines themselves due to its abrasive and electrically conductive properties. Over the long term, it damages mechanical components and can cause short circuits in electronic systems, making it essential for manufacturers to have a solution like this.

**Innovation award**

The European Association of Manufacturing Technologies (CECIMO) awarded ALDAKIN, IDEKO's partner in the FIBREMACH project, for these innovative developments in the first edition of the Machine Tools Innovation Award. Specifically, it received the first prize from both the public and the jury for the best innovation in the machine tool sector in 2023, recognizing IDEKO's pioneering contribution to the European industry to advance towards sustainable manufacturing and the adoption of clean technologies.

**The BIEMH demonstrator**

IDEKO's demonstrator at BIEMH is a robotic solution capable of simulating high quality machining of a carbon fiber aeronautical part. It is a demonstrator that simulates the machining process and incorporates all the developed technologies: the cameras and sensors for high-precision machining, dust suction mechanism, the markers that track the head with the tool… Additionally, attendees will be able to watch videos showing how the cell operates in a real environment.

**Application sectors:** Aerospace / Automotive **/** Wind power **/** Oil & Gas **/** Energy

## 2. Solutions for Diagnosing and Resolving Surface Marks

IDEKO boasts significant experience in increasing machining process efficiency and productivity through the introduction of cutting-edge technologies and advanced solutions. One of the most common problems in manufacturing processes is surface marks on parts, which can cause several issues such as affecting the product's aesthetics, compromising structural integrity, and reducing dimensional precision. These problems are particularly critical in sectors like machine tools, automotive, or aerospace industries where surface quality is essential for component performance and safety.

Surface problems often occur during grinding, as this process involves removing material with abrasive grains (grinding wheels) that can leave marks if not properly controlled. Another process prone to these problem is the machining of slender components made of aluminum and titanium, where distortions and residual stresses can create surface marks

These are very complex errors to characterize and resolve, as they are imperfections that can be smaller than a micrometer and are usually generated by combined effects of the process itself and the dynamic behavior of the machine or cutting tool. IDEKO specializes in measuring and analyzing surface marks in manufacturing processes,

identifying causes, and providing advanced technological solutions to reduce and eliminate them.

IDEKO employs advanced technologies for diagnosing surface topography and waviness marks, establishing a relationship between tool-part vibration and waviness characteristics. Through a simulation model, the research center can predict the effect of machine-tool vibration on surface topography. This measurement helps identify which failure frequency is generating the waviness characteristics. Based on this knowledge, IDEKO can characterize and resolve the marks; that is, identify the cause and avoid it. Additionally with this expertise, the technology center can also generate a controlled topography on the surface via the grinding process. This provides the surface with special functionalities such as improved lubrication, reduced friction and wear, or improved sealing capabilities. These functionalities are highly useful for components used in sectors such as automotive or railways.

**Texturing technologies**

One of IDEKO's innovative surface texturing technologies is Fast Dressing Servo (FDS). This technology is particularly notable thanks to its tribological applications, which can improve the friction properties of industrial components up to 30% using grinding techniques. FDS allows generating different textures by precisely controlling their geometry and distribution, leading to reduced friction coefficients and more efficient production in terms of both time and costs. It has been validated through tribological tests and is applicable for large parts like machine tool guides. Traditionally, these surfaces are textured by flaking, a manual, expensive, and non-repetitive method. IDEKO's FDS technology offers a more efficient, automated, controlled, and ergonomic alternative for texturing through grinding.

To avoid undesirable marks, IDEKO employs Virtual Vibration Absorber (VVA) technology as an advanced method for active reduction of forced vibrations, a particularly useful solution in high-precision machines used in sectors such as energy and aerospace industries. The VVA acts as an external actuator that can effectively eliminate vibration during the machining process, resulting in significant improvements in surface quality and precision of the manufactured parts.

Furthermore, the research center specializes in configuring optimal grinding processes based on application requirements and has technologies such as V3, adaptive grinding cycles that achieve process improvements in terms of quality and productivity while ensuring the reduction and elimination of different surface marks or patterns on parts such as helix or waviness.

**The BIEMH demonstrator**

In the next edition of BIEMH, IDEKO will showcase its ability to measure and characterize surface marks, identify causes, and provide solutions through implemented solutions in parts that show different industrial realities. Through them, the technology center will

exhibit its knowledge in various measurement and diagnostic technologies to resolve marks as well as in grinding processes.

**Application sectors:** Automotive **/** Aerospace / Railway / Machine tool / Capital goods

### 3. Active damping solution for boring bars

Internal boring or turning operations have the particularity that the dimensions of the tool are determined by the geometry of the hole to be machined. Given this characteristic, these tools often have a high slenderness ratio (Length / Diameter, L/D), which makes them prone to developing vibrations.

In cases of high slenderness (L/D > 7), it is not possible to perform stable machining if an anti-vibration solution is not integrated into the tool.

Currently, the market offers passive anti-vibration solutions integrated into the tip of the tool. These tailored solutions are based on introducing a shock absorber whose dimensions, weight and suspension frequency are designed specifically for each boring bar. Due to this, these solutions lose effectiveness in the face of variations in the cantilever length or deficiencies in the rigidity of the mooring. In addition, when the slenderness of the bar exceeds 10 times its diameter, the effectiveness of passive solutions decreases, which forces the use of advanced materials such as carbides to manufacture the body of the bar, greatly increasing the cost of the solution and making it unviable for large diameters.

To overcome these challenges, IDEKO has developed a modular active solution. This device is capable of counteracting the vibration generated during machining by means of an electromagnetic actuator. Through real-time vibration control, the active damper can adapt to variations in the free length of the bar, or even lack of rigidity resulting from the clamping of the tool. In addition, its modular configuration makes it a compact system that can be attached to conventional boring bars.

Specifically, the technology center will show a 3-meter-long boring bar that integrates active vibration damping technology developed by IDEKO.

The solution solves the limitations of current commercial systems to eliminate the vibrations that appear in the machining of slender, large-sized and high-cost parts in which chatter can damage their quality.

**Application sectors:** Cutting tool manufacturers / Paper industry

### 4. AI applications to improve the competitiveness of the industry

IDEKO's commitment to design and implement artificial intelligence (AI) solutions aimed at optimizing the productivity and efficiency of the industrial sector, especially SMEs, will also be present at 32BIEMH.

This commitment, which is also the result of close collaboration with the entire industrial ecosystem, has resulted in the implementation of several use cases aimed at both the monitoring of critical machine components and the detection of anomalies in the operation of the machinery.

These programs have been possible thanks to the extensive data collected from the sensor networks installed in machines worldwide. These sensors allows the monitoring of machinery operations, providing essential information to optimize different processes. This continuous flow of data capture allows IDEKO to monitor the status of components and detect anomalies.

Artificial intelligence is fed by a large amount of data from sensors deployed in industrial machinery. Thanks to the application of artificial intelligence to manufacturing, companies can avoid breakdowns and unscheduled production stops, increase the availability of equipment and guarantee its optimal performance when producing parts and components with high added value.

## Artificial intelligence for industrial companies

The **IDEKO**'s booth at the Machine Tool Biennial will host the celebration of "**ID**GOSAR**IA**", **three workshops** between **June 4 and 6** aimed at showing the advantages of the implementation of artificial intelligence processes for industrial companies. Attendees will be able to enjoy breakfast exchanging of ideas and knowledge. The head of the ICT and Automation research group at IDEKO, Iñigo Bediaga, together with an expert from the industrial company, will be in charge of explaining the benefits that the transformation of data into useful information through these digital tools has for companies. towards the optimization of production processes.

The talks, which can be followed live or via streaming, will discuss applications in the aeronautical and railway sectors:

- <u>Digitalization and exploitation of manufacturing data in the aeronautical and aerospace sector (June 4 at 11:00 am).</u>

The aerospace industry faces great challenges due to the need to design new aircraft and more sustainable components, meeting high quality and safety standards, in an increasingly competitive environment. These challenges are directly transferred to manufacturing sector, where strict quality standards mean errors are inadmissible.

This talk will explain the digitalization of production machines, as a tool for the advanced exploitation of data that allows optimizing the availability and manufacturing processes of components in the aeronautical sector. It will start from the need to implement computing platforms in Edge and Fog for asset monitoring, and the exploitation of data will be achieved through computational analytics and artificial intelligence applications in various use cases with companies such as ITP Aero, Airbus or Aernnova.

- <u>Digitalization in the production process of components in the railway sector (June 5 at 10:00 am).</u>

The railway sector is undergoing a transformation in its operations, systems and infrastructure, and also in the field of its manufacturing. The digitization and automation of production processes, which enable the advanced exploitation of data, lead to improvements in availability, efficiency and quality.

This talk will explain simulation, digitalization and automation projects of various production processes of railway components of the CAF company that have made use of data from their machines to improve availability, efficiency and the quality obtained in the plant.

> - Savvy Fog powers the CFAA Aeronautical Advanced Manufacturing Center in artificial intelligence (June 6 at 10:30 a.m).

Savvy Industrial Platform is an Edge-Fog-Cloud continuum platform that offers great versatility and flexibility in its deployment, allowing the creation of a solution adapted to each case. Savvy Fog technology is the machine data exploitation platform that allows you to easily manage the entire ecosystem of Savvy Edge devices in production plants, from a single on-premise control point, in a scalable and cyber-secure way.

In this talk, the Savvy Fog on-premise solution implemented at the Aeronautical Advanced Manufacturing Center (CFAA) will be presented. Savvy Fog will allow the management of data capture from the nine monitored machine tools, as well as the orchestration and deployment in the Savvy Edge of data analytics and artificial intelligence applications developed by the center's researchers.

**IDEKO, also present at Innotech and Biemh Talks**

In parallel to its participation as an exhibitor, the IDEKO technology center will also have a prominent presence in the Innotech program, an exhibition area and talks on research and innovation projects co-financed in different European programs organized by Innobasque. The area will be located in Pavilion 4 (F28).

Specifically, IDEKO researchers Asier Barrios, Xavier Beudaert and Peio Olaskoaga will present the advances developed in the following projects:

- Monday June 3 at 11:10 - Laserway, funded by the Horizon Europe program. Xavier Beudaert, Head of Dynamics and Control research group at IDEKO, will present the development of high-speed laser processes for sustainable and flexible manufacturing is promoted.

- Monday, June 3 at 11:30 - InterQ, funded by the H2020 program. Xavier Beudaert will explain the work carried out as leader of the initiative to achieve exhaustive monitoring of manufacturing processes, prevent errors in time and guarantee the quality hallmark of the parts, moving towards zero-defect manufacturing.

- Tuesday June 4 at 11:50 - Infinite, funded by the Horizon Europe program. Peio Olaskoaga ADMP technology expert, will give the example of this project led by IDEKO

and which seeks to develop digitally sensorized aeronautical components to be able to monitor the manufacturing of the components and their structural health throughout their entire life cycle.

- <u>Wednesday, June 5 at 11:30</u> - [Fibremach](#), funded by the H2020 program of the European Union. Asier Barrios, expert on Robotics, will explain the details of the robotic system developed for clean, precise and safe machining of composite materials.

The final program will be available soon [in this section of the BIEMH 2024 page.](#)

In addition, the technology center will also share its knowledge in automation and robotics and the digitalization of industrial processes in the official BIEMH talk program.

On the one hand, Asier Barrios will show a success story in automation together with Víctor Malita, head of robotics for machine tools at Siemens, within the framework of Automation and Robotics Taks on June 5 at 12:55.

And on the other hand, Nerea Aranguren, General director of IDEKO, will participate on Tuesday, June 4 at 10:55 in Digital Talks in a debate panel on the application of AI in the manufacturing industry.