HORIZON-CL4-2026-02-DIGITAL-EMERGING-51: AI improved advanced manufacturing and production processes in factories (RIA)

1. General context of the topic

This topic aims to enhance advanced manufacturing processes through the use of **explainable artificial intelligence (XAI)**, adaptive optimization, and real-time digitalization. The proposed solutions should contribute to increasing industrial competitiveness, reducing environmental impact, and facilitating the transition toward a circular industry.

2. Potential contributions from CARTIF

a) Industrial process optimization through hybrid and physics-informed AI

- Application of **physics-informed AI models** to link process modeling and optimization for complex industrial operations (e.g., drying, thermal treatment).
- Application of **AI-based algorithms for optimal automated process control**, such as drying operations, considering multiple minimization constraints (e.g., energy, temperature, etc.).
- Integration of **self-X mechanisms** for drift detection and correction in AI models, building on CARTIF's experience in the **s-X-AIPI** project, where an *autonomic AI pipeline* approach was coordinated.

b) Data integration and creation of an interoperable Data Hub

- Development of a **FIWARE-based Data Hub** to integrate heterogeneous industrial data (sensors, process, quality, maintenance, energy…), leveraging experience from the **CARTIFactory FIWARE iHub**.
- Promotion of data interoperability and standardization aligned with the European vision for **Industrial Data Spaces**.

c) Explainable AI for quality control and decision support

- Development of **explainable AI tools** (post-hoc and ante-hoc) based on XAI toolbox concept (previous proposal), including the use of **LLMs for explainability** and **explainability of LLMs themselves**.
- Use cases focused on **defect detection**, **vision-based quality control**, and **production process optimization**.

d) Circularity and industrial sustainability

- Integration of **circular economy strategies**: classification of by-products, material reuse, and design for circularity supported by digital tools (DPP, Material Passport).

- Application of AI to **optimize material flows** and maximize the use of regenerated components.

e) Collaborative automation and cognitive robotics

- Implementation of **natural human-robot interaction** and **autonomous robotic systems** applied to flexible manufacturing.
- Leverage CARTIF's expertise in **advanced robotics**, **collaborative manipulation** and **soft robotics**.

3. Target industrial sectors

CARTIF can particularly contribute in the following sectors identified in the comments:

- **Automotive and industrial components.**
- **Food-processing industry** (smart packaging, intelligent manufacturing,).
- **Process industries** (minerals, lead recycling, steel, aluminum, bio-based materials…).