
## 1. Entity posing the challenge

**UPTEK: IBARMIA, LANTEK, LOIRE, ONA, ZAYER**

## 2. Challenge

**How can we improve the health and condition of machine tools and optimise production processes by applying artificial intelligence?**

## 3. Possible solutions that can be applied

- Fingerprint (machine fingerprint)
- Digital twin of the machine
- Machine learning: pattern analysis and smart prediction of failures in critical elements
- Data Intelligence / Intelligent automation

## 4. Context

SMEs that outline this challenge see artificial intelligence as the backbone on which they want to build their future business models. Models that evolve from selling assets to servitising them, or, in other words, to selling advanced services around a more "intelligent" use of machine tools and the data they generate. Services such as monitoring the **condition/health of machines** and their **predictive maintenance**, or better **visualisation** and **autonomous decision-making** to optimise production cycles.

In the first case, more and more customers are asking machine tool manufacturers for **equipment with systems that provide knowledge about the state of health of machines and their components**, which is a critical and indispensable task when it comes to maintaining the machine's performance and productivity. In this sense, and in many cases, manufacturing companies are unable to access or do not have access to machine usage data from their customers, and, if they do, it is often disjointed or of no value in itself. In addition, working on **predicting failures of critical components** requires entering an area of special knowledge that is different from the more general proposals on the market, and the challenge arises because **developments are based on a specific approach to the system and its processes**.

As far as **optimising production planning** is concerned, companies that manufacture components or parts and have **connected production lines**, and therefore machine usage data, would like to **collect, process and correlate data better from different machines and equipment** in order to achieve greater production efficiency (both in terms of quality and energy). This is because machine productivity is still very much linked to the planning done by the production engineer, and the use made of the machine by each operator. This leads to inefficiencies in the operational pattern of the different production lines, resulting in time losses and failure to meet line cycle times.

## 5. Subsidiary challenges and objectives

As can be seen from the above context, two challenges are envisaged for applying artificial intelligence:

1. **Knowing about and improving the health of the machine and providing predictive maintenance services:**
   - **By generating fingerprints from the machine in order to regularly monitor** the state of health of its components, based on the values of CNC and sensor variables, which are obtained while running check cycles, and comparing them with the values obtained when the machine was set up. The application of data mining techniques to the fingerprints obtained throughout the life of the machines will make it possible to set new limits for deviations from the normal pattern, and data for more robust fault detection. Moreover, the data processed through the fingerprint tests and the operational data are waiting to be sent to a platform ready for exploitation, although in some cases, the companies proposing the challenge do not have enough labelled data, which is a challenge in itself. This platform is also expected to be able to capture, process, store and exploit all the data, and correlate them with the real condition of the components and machines in order to know how they behave in use, improve the system's diagnostic and predictive capabilities, and, in short, to facilitate decision-making to improve the performance of machine tools.
   - **By creating digital twins of the processes**, which would make it possible to visualise the variation and behaviour of the machine parameters if the production parameters were altered in the event of poor connection/availability of data.

2. **Improving the efficiency of production lines, and reducing human supervision and intervention during the different manufacturing stages**, by synchronising the systems connecting the machines to AI algorithms, so as to obtain useful knowledge to improve production cycles, as well as energy, water, cooling, air and other consumption patterns, in order to improve the energy efficiency of the machines.