1. Entity posing the challenge:

- **TIVOLY, IBARMIA, IZAR, LANTEK, LAZPIUR, COMETEL, ONA, DIMECO**

2. Challenge statement

Data intelligence to optimise internal and external processes

3. General context

The manufacturing industry is facing a new global context meaning the model must be reconsidered in all areas. This implies a structural challenge with profound operational, technological, and cultural implications throughout the value chain.

In this new context, and mainly thanks to greater data processing and storage capacity, greater maturity, and improved applicability to industrial environments, the traditional product is moving towards connected products. Greater importance is being placed on additional services linked to this product, which is opening the door to disruptive models that evolve from the sale of the asset, to the sale of the use of this asset.

This digitalisation of the manufacturing industry opens up possibilities to improve each stage of the industrial process, generating a direct business impact and providing an opportunity to improve both productivity (cost efficiency) and to develop new products and services which increase competitiveness (added value for the customer).

AFM Cluster member companies in general, and Uptek in particular, are directly involved in the context described above. Their activities are directly related to:

- Development and commercialisation of software solutions for the M-H sector
- M-H manufacturing applied to different processes (milling and boring, electrical discharge machining, cutting, punching, bending, etc.)
- Manufacture of tooling and spare parts

In terms of products, it should be noted that these companies have a heterogeneous business model. Some of the companies focus on standard products and others on customised products and even turnkey projects.

While there is a considerable difference in the production processes of these companies, they face certain common challenges at the internal operational and product level that can be addressed through 4.0 technologies.

4. The Challenge

1. **Description of the challenge:**

The intelligent use of data represents an opportunity to create disruptive business models evolving from selling the asset to selling the use of the asset, i.e. developing new customer relationship systems, also known as Digital Business.

Digital Business requires offering added value to the customer by orienting the offer in the form of services. These services will be based on digital solutions and can range from remote diagnostics and machine health diagnostics to predictive maintenance, support in improving customer processes, and predictive quality.

On the other hand, Digital Business also opens up a huge range of opportunities in the production chain, increasing productivity, reducing costs, and gaining efficiency based on analysing the data generated and algorithms that optimise the production chain in real time.

Two individual challenges are envisaged from these two lines of work, firstly at the product/service level and secondly at the process level:

- **Application of AI-Machine Learning technologies when little data is available at process level**

Machine Learning technologies are widely used for industrial Predictive Maintenance, although other types of Artificial Intelligence can also be applied to production processes. In this sense, the SMEs participating in the challenge are working on having their machines learn from real-world incidents (unexpected stoppages, urgent orders, staff shortages, etc.), and identifying non-quality patterns. This reduces repeat work and increases production agility and speed. At the same time, the customisation demanded by customers with tailor-made orders, requires automatic learning for customer machines to reduce operator dependence.

The main challenge in this respect is to solve the existing problems associated with the use of Machine Learning technologies when there is little data available. Cases where the use of "synthetic data" to feed these systems, which are generated from computer simulations or algorithms, provide a cost-effective alternative to real-world data.

- **Visualisation and simulation of process parts for production optimisation**

In a quest to make industrial processes as productive and flexible as possible, the market demands that the SMEs posing the challenge provide processes with autonomy and knowledge, so that they can adapt to the changes demanded by customers with respect to the products, processes, or services they offer in real time.

Thus, there is a need to create virtual models of the processes, products, or services through the information obtained from sensors and automatisms. In this context, the opportunity

arises to create virtual representations of the physical world and its relationships, creating digital models that can be used as a test bench, which optimise the manufacture of a specific element. Digital twins are positioned as a key part of the digital transformation of the MH sector, as they allow new processes, services, or products to be simulated. This can cover the design and prototyping phase through to the operation and maintenance phase.

2. Main impacts:

The application of Machine Learning technologies will serve to analyse whether value could be provided to end customers, based on the data provided and by semi-automating some routine maintenance tasks.

The application of digital twin models will facilitate comparisons of deviations between the simulation of the part to be manufactured from digital design programmes such as CAD/CAM, and the simulations generated from the part's production programme. Another aspect of interest would be for AI to provide information on the part "output" (and even visualise it), to anticipate errors that could be made in the manufacturing process before it starts and to prevent the parts from being damaged. This would prevent Manufacturing Orders from being launched if the final part is predicted to be defective based on any of the parameters used.

3. Main questions to be solved:

- Would it be possible to develop predictive maintenance algorithms for the customer in a data scarcity context?
- Would it be possible to bring value to end customers through Machine Learning solutions and the data obtained from them by "semi-automating" some tasks?
- Would it be possible to develop intelligence so that the machine can learn through its use in the real world?
- Would it be possible to develop a digital twin for both online and offline process control?
- Would it be possible to develop a digital twin of the machine to optimise the production of the "first part"? (Considering that a single machine is capable of developing multiple parts).
- Would it be possible to develop a digital twin that visualises how work flows will change if production parameters are altered?

4. Expected technological solutions

The technological solutions expected to address the above challenges are:

- Artificial Intelligence applied to maintenance processes (predictive maintenance).
- Product and process digital twins.
- Machine Learning.