1. Entity posing the challenge:

- **AZPIARAN, FLANKER, GARITA & METAL GROUP**

2. Challenge statement

Product traceability and production process improvements using Sensorics, applied in safe environments

3. Context

The automotive industry is made up of complex supply chains, which over time have evolved into a global production network. Although only a limited number of countries and companies lead automotive production, the industry's value chain spans the globe and a large number of companies are involved in the design, development, manufacturing, marketing, sales, repair and maintenance of cars and automotive components. On average, each vehicle contains more than 20,000 parts, which original equipment manufacturers (OEMs) source from thousands of different suppliers. The value chain has increased in recent years, integrating new agents from different fields of knowledge and expertise.

The automotive industry has demonstrated remarkable resilience over the years. It has successfully recovered from the last global financial and economic crisis and continues to make a significant contribution to GDP, world trade, and employment.

Right now, the automotive industry is at a turning point: it faces the digital revolution, environmental challenges, climate goals, societal changes, and increasing globalisation. The main trends driving this transition are the development of new technologies in areas such as automated driving, further digitalisation of manufacturing, reducing the impact of vehicle pollution on the environment and health (a crucial competitive issue which is expected to bring about an increase in global demand for electric vehicles), and societal challenges (such as changes in consumer preferences and an ageing population).

The industry is generally assessing and redefining its position in the value chain, as well as increasing its capacity to add more value in its product portfolio and production processes.

Within this context, the Basque automotive components sector is positioned as one of the most competitive and innovative in the world, characterised by its advanced level of management, high degree of effectiveness, and efficiency. The Basque sector also stands out its ability to integrate, as it brings together the entire value chain within a very small area. It integrates steelmakers, capital goods manufacturers, machine-tool producers, tooling and die makers and machinists, as well as universities, research centres, consultancies, and engineering firms.

At the local level, which is completely interrelated to the international context, SMEs in the sector face different challenges that condition their production activities and business operations. Some of the most significant conditioning factors are the following:

- the **high quality specifications** demanded by the main brands in the sector as well as OEMs;
- the increasingly **demanding functional requirements**, which increase the complexity of the manufacturing processes;
- **product designs which are predetermined by customers** leave little room for manoeuvre for the manufacturing companies;
- the demand for **high cost efficiency** which is closely linked to the improvement of productivity ratios, and is also conditioned by the product designs.
- the importance that SMEs must give to revaluing and optimising their production processes in order to provide value when they **lack their own products**.

In this context, some SMEs of the ACICAE cluster have visualised certain common areas of work in order to improve their competitive position in the market, and this is where the following challenge arises:

4. The Challenge

1. Description of the challenge:

Three data-related areas that companies in the automotive sector can work on to significantly improve the productivity of their manufacturing plants are: capturing and obtaining data through Sensors, processing it using Big Data, and practically applying the data by using Artificial Intelligence technologies.

In the case of auxiliary vehicle part and component producers, major efforts are being made to optimise the traceability of both the materials/products entering/leaving the plant and internal movements. Likewise, regarding manufacturers of the machinery used to produce these components, a challenge that will need to be tackled to preserve the competitiveness of the Basque sector is to obtain data using sensors. In particular, data on how the customer uses their product.

- **Product traceability**

The application of sensors can improve the external traceability of the product once it has left the plant and sent elsewhere for some subcontracted activities. This would avoid having grey areas without data, and it will require agile and efficient information exchange solutions. With all of the above, SMEs will no longer have to work with large amounts of stock to prevent production stoppages.

On the other hand, and at an internal level, sensors can help to understand how parts and materials move in the plant during the production process, in a context where thousands of references are manufactured for multiple customers and sometimes with production facilities in different locations.

- **Process improvement**

Equipping machines with sensors (die cutting machines, tooling, etc.) and monitoring their production lines would enable companies to optimise production, thus reducing possible breakdowns or bad/defective parts, but above all making the tooling safer. Although most companies have advanced and digitised installations (including the collection of production parameters and continuous improvement processes), there are some problems related to the digitisation of the installed fleet. This is mainly due to the different ages of the machines, as well as their origin from different suppliers (which implies, among other things, different connectivity, automatons, operating systems, and data deployment).

- **Secure monitoring platforms**

Providing processes and products with cybersecurity is essential for companies in the automotive sector. In a field where systems increasingly have greater connectivity to monitor and manage them remotely, there is also a risk of suffering from attacks or intrusions in the connectivity chain. In this regard, companies are calling for new technologies to increase the protection of embedded electronic systems that are connected to digital platforms. At different levels, participating SMEs aim to obtain and implement cybersecurity solutions covering the entire value chain: from the sensors, electronics, embedded software, connectivity solutions, data processing and intake platforms, to analytics and advanced visualisation.

For this challenge, the participating SMEs are looking to create a **PLC (Programmable Logic Controller) data monitoring platform for their machines** that can be deployed in **cloud or on-premise environments**, or as an "island added to the manufacturing environment". Above all, this platform must **comply with the cybersecurity specifications** issued by the customer.

The idea is to concentrate all the data from a machine in the PLC (such as data from sensors, timers, and other input signals) and transmit them to a platform via an MQTT through a gateway that complies with all the cybersecurity aspects set by the customer. The challenge here is to **create a platform that is sufficiently secure for the customer to agree to providing this information, which implies the need to equip the communication systems with VPN encryption**. This involves **creating secure protocols** to protect sensitive data within the VPN client - VPN server tunnel to ensure that no one can exploit it.

2. Main impacts

Implementing sensors in the products (both parts and machines) will allow full traceability of these products to be transmitted to the end customer (OEM). In this way, the supplier company can offer added value by providing information that was previously unknown as a quality guarantee. This will result in increased customer confidence.

On the other hand, this traceability could be used to adjust manufacturing orders as much as possible. At the same time, the logistics of inputs entering the factory could be optimised, as this logistics is conditioned by a diverse panorama of external agents that companies in the sector work with. While internal operations could be improved by adding intelligence to products, applying sensors in a sector that is particularly associated with metal components could result in drawbacks (as interferences often arise with the main sensor technologies/IoT).

At the **process improvement** level, while each machine has its own safety system, the design of the tooling itself causes occasional errors. The application of sensor technology will allow productions to be more stable, and parts will come out with fewer errors, increasing efficiency.

Finally, the deployment of secure parameter **monitoring platforms** (parameters collected from machine PLCs) will allow companies to use the information from their sensors to view quality correlations in machine operation. It would also be possible to monitor stoppages, breakdowns, and calculate certain KPIs based on historical data in the cloud (which provides a greater amount of data compared to local data and faster calculation speeds).

3. Main questions to be solved

- Would it be possible to apply sensors to products (parts, machines, others) to increase their traceability and thus work with smaller stocks and more accurate production orders?
- Would it be possible to apply sensors to products to understand their behaviour in the plant and thus optimise production lines/processes?
- Are there sensors that can be applied to metallic/ferrous materials?
- How can sensors and information from different machines of different ages with different operating systems be integrated? Would it be possible to create a unified platform for data collection and processing?
- Would it be possible to deploy a monitoring platform that securely collects PLC data from machines in a cloud environment? And in an on-premise environment? Or failing that, as an “island added to the manufacturing environment”?
- What cybersecurity protocols would have to be provided to the customer in order to share this data?

4. Expected technological solutions

The technological solutions expected to address the above challenges are:

- Sensorics (IoT)
- Secure and embedded sensor monitoring platforms
- Secure cloud solutions