

FENICE'S

HIGH-TECH

STEERING WHEEL

Assembled on Trento Racing Team's new E-Agle one-seater, it has been built with the help of ProM Facility

Formula SAE (Society of Automotive Engineers) is an international engineering design competition for the engineering departments of universities around the world that involves **designing, building, and racing single-seater racing cars**. It is a kind of miniature Formula 1 that takes place in the summer on major circuits such as Silverstone, Hockenheim, Spielberg and Barcelona. The Trento racing team, founded in 2016 and called E-Agle Trento Racing Team, has immediately distinguished itself for the technology and innovation present in the single-seater's steering wheel, in particular, so much so that in 2017 it won the first overall prize for the best telemetry system and, in 2018, the prestigious Lamborghini Prize for the best HMI (Human-Machine Interface) system. Not satisfied with these successes, the team has now entirely redesigned the steering wheel to make it even more technologically advanced and ergonomic. Valuable at this stage was the support of ProM Facility, the rapid prototyping workshop of Polo Meccatronica, the high-tech incubator of Trentino Sviluppo,

that has been supporting the team for the last seven years now in the design, development and building of the car's components.

The steering wheel of the new Fenice concept

To stimulate competition among the students, Formula SAE regulations require the various racing teams to make changes each year to their single-seaters, particularly to the chassis. The Trentino team, comprising 65 Engineering, Computer Science and Economics students, started with Chimera in 2017 and then switched to a higher-performance version of it, Chimera Evoluzione. With the new Fenice single-seater, which will be presented to the public soon, the Trento students decided to conduct a different operation. They ideally burned Chimera Evoluzione to give birth to this Fenice ("phoenix") from its ashes. An entirely new concept, more aerodynamic and technological, in which even the steering wheel has been revolutionised, with the aim of adding new inputs and of improving its ergonomics.

The steering wheel's body

First, work was done on the handles that were moulded from two blocks of synthetic clay shaped by taking the exact imprint of the pilot's hands. The geometry was captured with a 3D scanner and printed in the ProM Facility in TPU with an HP Multijet Fusion 4200 printer. The result is extremely ergonomic and fully customised handles that provide the driver with greater grip.

The body of the steering wheel has also been redesigned and made entirely of carbon fibre, a detail that gives it an F1-style look. In addition to the three dials and two buttons already on the Chimera steering wheel, it was decided to add two buttons on either side of the screen and a dedicated start & stop button for vehicle ignition, and there are now four paddles on the back instead of two.

FORMULA SAE: TRACK HISTORY

For this year's Formula SAE, the E-Agle Trento Racing Team entirely redesigned the single-seater steering wheel to make it even more technological and ergonomic. Valuable support from ProM Facility, the rapid prototyping workshop of Polo Meccatronica, Trentino Sviluppo's incubator

The size of the screen has also been increased, which now has a coating that improves its visibility in direct sunlight. The steering wheel is fastened to the car with a quick-release attachment that allows it to be easily removed to get the driver in and out of the car.

The electronics

The electronics within the body of the steering wheel are mainly composed of a high-performance mini-computer (Raspberry Pi 4) mounted on a circuit board specially designed by the team, which allows it to connect to the car's network of control units (CANbus) and to interface with the buttons, dials, and paddles mounted on the steering wheel body. ProM Facility helped the students assemble the boards using a 'pick-and-place', a precision machine capable of semi-automatically placing and soldering microchips onto the board.

The graphics

The graphical interface too has been redesigned with respect to the previous version and displays to the pilot as a series of different pages, each with a specific purpose.

The **racing page** is entirely dedicated to the driver and shows current speed, voltage and battery power of the motors, i.e., the information needed when the vehicle is moving.

The **sensors page** on the other hand, shows the status of all connected ECUs, so the pilot can quickly check if all the on-board electronics are fully operational or if there are any issues and errors.

Finally, the **GPS page** takes advantage of the eponymous sensor in the car to show the precise location of the vehicle on several racing and testing circuit maps.

When the vehicle is in motion, the driver can independently set power limitation, cooling control (pumps and fans) and torque vectoring via the dials. Unlike in Formula 1, other changes, configurations and calibrations are made while the car is stationary. The steering wheel is also an indispensable tool for track engineers who, together with the pilot, can configure every aspect of the car, assess the status of all ECUs, calibrate sensors and identify and solve problems without having to connect remotely in order to diagnose any errors.

Formula SAE arrived in Europe in the early 2000s based on the American model, which debuted in 1981. In Italy it saw its first edition in 2005. During each competition, teams have to face several challenges divided into two categories. The first consists of static events, i.e. the presentation of the car's design, the simulation of the presentation in front of potential investors and the analysis of the production cost report. The second category instead consists of track events and involves Acceleration, Skid Pad, Autocross, TrackDrive (autonomous driving) and Endurance tests.

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