

ARTICLE

Technological challenges at the cutting edge of knowledge

- *One of the main challenges the science industry is currently facing is related to designing and building scientific facilities that are more compact, autonomous, secure and sustainable.*

The aim of the science industry is to address major challenges and enigmas that can be found at the cutting edge of knowledge. An example of this can be found in a number of discoveries and milestones reported in recent decades such as the Higgs boson in the field of particle physics; the first picture of a black hole (M87) taken in space explorations or the first fusion demo that used inertial confinement.

It is a booming market that generates and applies innovative technological solutions for which there has to be a constant transfer of knowledge as well as an exchange of experiences between all the agents involved in the process (companies, universities, technology centres and large scientific facilities).

This collaborative R&D action is currently addressing the challenge of implementing projects that will mark a turning point in terms of scientific development and whose aim is to find answers to major questions posed by mankind. There are several issues of interest such as the commissioning of the unprecedented CERN scientific facilities, the world's largest particle accelerator, the James Webb telescope or the ITER experimental reactor.

Although what the future holds is unknown, Europe is solidly positioned thanks to the continent's involvement in several outstanding projects and because a budget of nearly 40 billion euros has been estimated to cover the next four years.

The contribution of Spanish R&D

As regards the European Union, Spain is playing a major role. Thanks to the experience accumulated over the last 15 years, Spanish industries can now lead top-level technological projects and provide major scientific facilities.

Proof of this can be found in the fact that Spain is a high-ranking nation in terms of contracts associated with nuclear fusion projects. The country will also provide a location to set up the facilities required by this growing sector for IFMIF-DONES, an innovative particle accelerator that will be commissioned in a Spanish town called Escúzar (Granada).

Another outstanding element is the significant contribution made by Spanish R&D for the construction of Europe's largest spallation neutron source in Lund (Sweden) that has a branch in Bizkaia (ESS Bilbao).

Lastly, and as regards astrophysics, several national companies form part of leading international consortiums participating in the construction of various cutting-edge facilities such as the ELT (Extremely Large Telescope) or the telescope in operation at the Rubin observatory. Both are located in the Atacama desert (Chile).

Technological challenges

Nowadays, and when seen from the technological perspective, one of the biggest challenges the science industry is facing is related to designing and building facilities that are safer, more compact, autonomous, and sustainable.

There are other challenges associated with data gathering and management and with the so-called trend of "virtual commissioning" that consists in virtually testing, verifying and validating the results of experiments before they are carried out.

Innovative solutions must be developed to meet these challenges. The involvement of technology centres, therefore, will be crucial to close the gap between these needs and the industrial fabric. Training must also be provided to allow companies to properly deal with these challenges.

Tekniker's role

Technology centres like Tekniker must play a central role in the implementation of science industry projects.

The extensive knowledge that Tekniker already possesses in the terrain of ICTs has allowed the organisation to advance in areas related to control, automation and connectivity of cutting-edge scientific facilities thanks to having developed sensors, actuators, robots and other stand-alone systems.

As regards mechatronics, the technology centre is developing systems that can operate in environments characterised by extreme temperature, radiation or vacuum levels. An example of this can be found in the Remote handling project in which Tekniker has combined its capabilities with regard to designing and automating equipment whose goal is to develop a mechanism that can operate remotely at the neutron source in Sweden and at the Muvacas facilities; a customised test bench to further research associated with nuclear fusion where in-house expertise has been applied to ultra-high vacuum equipment (UHV).

Internal know-how has also allowed the technology centre to design customised solutions that will improve accuracy whenever large infrastructures such as the telescope at the Rubin Observatory are set into motion. Tekniker has been asked to design and develop software as well as control and safety algorithms that will not only allow the telescope to achieve a high degree of accuracy when in motion, but also to run smoothly and vibration-free.

The technology centre will also deliver cutting-edge technologies in the area of advanced manufacturing in the form of laser, ultrasounds, additive manufacturing or white room processes to offer new capabilities, improve manufacturability, accuracy and, ultimately, enhance company competitiveness.

Tekniker is also involved in projects focused on improving the properties of materials and incorporating new functionalities with technologies such as PVD or Sol Gel. The technology centre has already collaborated, for instance, in the development of smart coatings to avoid cold-welding parts used on satellites in space missions such as Solar Orbiter (SoIO), ExoMars and JUICE.

Tekniker has placed all of these innovative technologies at the disposal of leading scientific facilities to manufacture components that are safer, more compact, efficient, autonomous,

and sustainable without ever losing sight of the surrounding industrial fabric nor of how the knowledge originating from the different projects carried out in the area of science industry can be transferred to them.

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