News

No. 81

gmv INNOVATING SOLUTIONS

Artificial intelligence for driving post-pandemic precision medicine

INTERVIEW
Ana Céspedes
IAVI Chief Operating Officer

Innovation and security in biomedical research: two sides of the same coin

24 May
Fundación Pons. C/ Serrano, 138
On-site

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www.innormadrid.org

Innormadrid, North Madrid's Innovation Promotion association, with the collaboration of GMV, holds the forum "Innovation and security in biomedical research: two sides of the same coin".

The forum will address biomedical research challenges thrown up by cybersecurity-based digital medicine tools. It will also look at the value of responsible and secure innovation and the role of digital technology in the development of new drugs by companies and institutions.

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Letter from the president

The coronavirus pandemic is still affecting us all but it's also a clear example of how the same virus can affect people very differently. Risk groups for whom the disease is likely to be serious or even lethal have been identified, but even within these groups some people have caught COVID-19 asymptomatically. Likewise, some recover quickly while others' symptoms drag on for months.

The human organism is a fiendishly complex system. Each human being, moreover, is unique, our bodies reacting in different ways. The way diseases affect us or how we respond to medication is determined by such factors as our genetic makeup, gender and age but also our lifestyle, diet, level of exercise or even our mood swings.

Personalized medicine takes into account all these individual factors instead of the traditional "one-size-fits-all" approach and accordingly draws up individual prevention-, diagnosis- and treatment-procedures. The downside is that such an approach has to be resource-intensive in order to factor in all the variables that might impinge on any individual reaction to a pathogen or drug.

This is where artificial intelligence's tireless information-processing prowess comes into its own, making it feasible to search for patterns in a slew of data combining many sources and diverse types of information in order to diagnose diseases, predict the likely response to a treatment and pinpoint possible cause-effect relationships.

GMV is spearheading the development of AI-based solutions to comb through confidential data from several different privately-own databases in a collaborative and decentralized way, without moving the processed information from its original site and safeguarding its security and privacy. To preserve two of our most precious assets: our health and our freedom.

Mónica Martínez

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CONTENTS

3 **LETTER FROM THE PRESIDENT**

6 **ARTICLE**
Artificial intelligence for driving post-pandemic precision medicine

12 **INTERVIEW**
Ana Céspedes
IAVI Chief Operating Officer

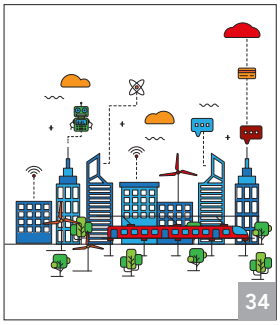

6


12


16


18


30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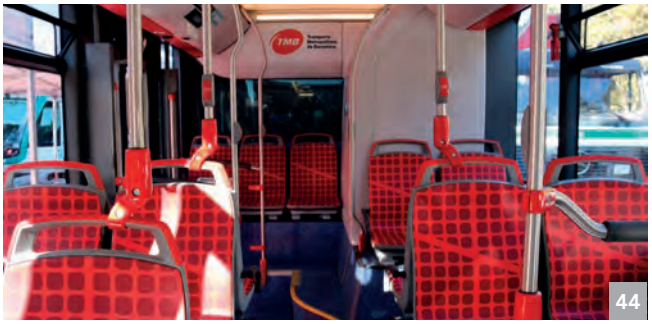
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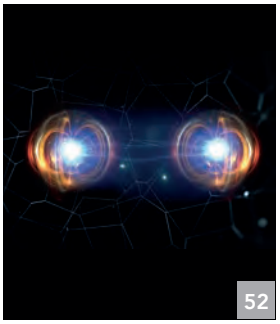

52


60

16 **AERONAUTICS**
Spanish Navy tests Seeker UAS in Exercise FTX BRIMAR 21

18 **SPACE**
Operational Optical Data Services for Meteosat Satellites

29 **ROBOTICS**
GMV applies robotic technology to prospecting and mapping the moon

30 **DEFENSE & SECURITY**
GMV's 2020 EDIDP projects kick off

34 **CYBERSECURITY**
Smart and Cybersecure Cities

40 **HEALTHCARE**
AI-guided acquisition of diagnostic ultrasound images

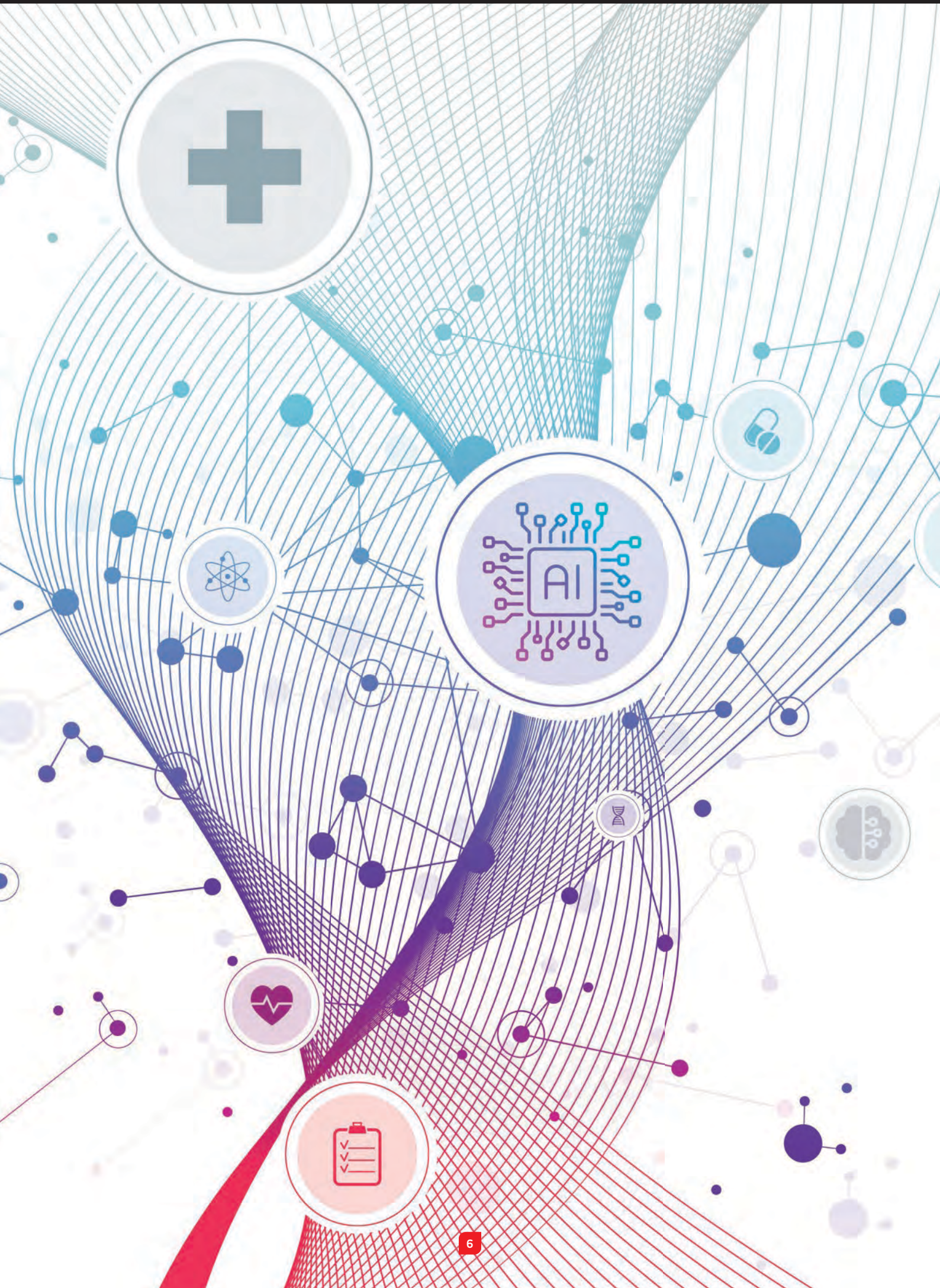
44 **ITS**
GMV to supply the new passenger-information and video-surveillance system for Barcelona's urban buses

50 **AUTOMOTIVE & MOBILITY**
GMV wins the Galileo Green Lanes extension contract

52 **ICT**
Quantum computing and its application to strategically important industries

57 **CORPORATE INFORMATION**
GMV wins award for its R&D+i work with UPM

60 **TALENT**
The intergenerational handover, a perk of GMV's diversity strategy


AI

Artificial intelligence for driving post-pandemic precision medicine

Previous issues of this publication dealt at some length with the pandemic-onset situation. Soon afterwards a warning was given about cybercriminals' ruthless and heartless exploitation of this moment of human weakness, their attacks hitting both individuals and companies hard. We also reflected on its impact on our morale and shared our yearning for a golden-bullet vaccine to give us "our lives" back. Now, at last, more than two years after the onset of this health disaster, after several false dawns, a succession of six contagion waves and with a triple-jabbed population, we have to accept that our lives will never be the same again.

Our lives will never be the same for several reasons. Maybe the pandemic has brought us up hard against some forgotten but obvious truths. That life is a fleeting affair, that humankind is fallible, that we need less of the baggage we previously thought essential and perhaps more of things we had previously given little heed to. We have also seen how the nanny state has made us pathetically vulnerable if deprived of our gewgaws. It has been made even more obvious too that we live in an interconnected world with all the concomitant perils. In this case we have been incapable of shutting the doors on a lethal virus. Relocated and offshore production is another new factor, highlighted in this particular case with the initial scarcity of healthcare products; this leaves our fate in the hands of outsiders. Last but not least our country's productive system has been broadsided by the SARS-CoV-2 (COVID-19) virus.

The pandemic has also shown us the overriding importance of research and innovation, the development and production of vaccines and drugs to protect us from an aggressive virus like this one.

Here is where Machine Learning and Deep Learning come into their own, producing healthcare breakthroughs, especially in radiology, molecular pathology, proteomics, genomics or the design of new agents. GMV's digital technologies offer the chance to move on from a healthcare geared to treating disease to one geared to promoting health.

From the crisis comes opportunity

For some years now authorized voices have been warning us about the need of reorganizing Spain's health system to ensure its ongoing sustainability into the future. The essential thing, this argument runs, is to invest in the creation of an innovative and competitive production model with digitalization permeating all sectors across the board (spilling out from the pioneering finance sector), the healthcare sector standing in the most urgent need of this development. Spain's *Foro de Empresas Innovadoras* FEI – an association set up by professionals of recognized prestige to drive an innovation culture – has called in several publications for the essential digital transformation of Spain's economy.

Along similar lines, Spain's digital technology firms employer's association, AMETIC, brainwaved a model called "Macroproyectos Tractores", designed to drive the country in this direction. The healthcare Macro Proyecto Tractor, in particular, was drawn up by several collaborating stakeholders determined to stave off the collapse of Spain's health system as the population ages and demands more resources. These stakeholders include Fenin, Farmaindustria, SEIS, CEVE, AseBio, AECHAIN, FEFE, CEAPs, ASPE, AMAT, Fundación ONCE, Arahealth, ANEA and UNESPA

GMV, as a standout member of FEI y AMETIC was heavily involved in the work of offering managers viable, paradigm-shifting alternatives. In the particular case of the abovementioned proyectos tractores, it also took part in their presentation to the government before the onset of the pandemic, warmly welcomed and received at the time.

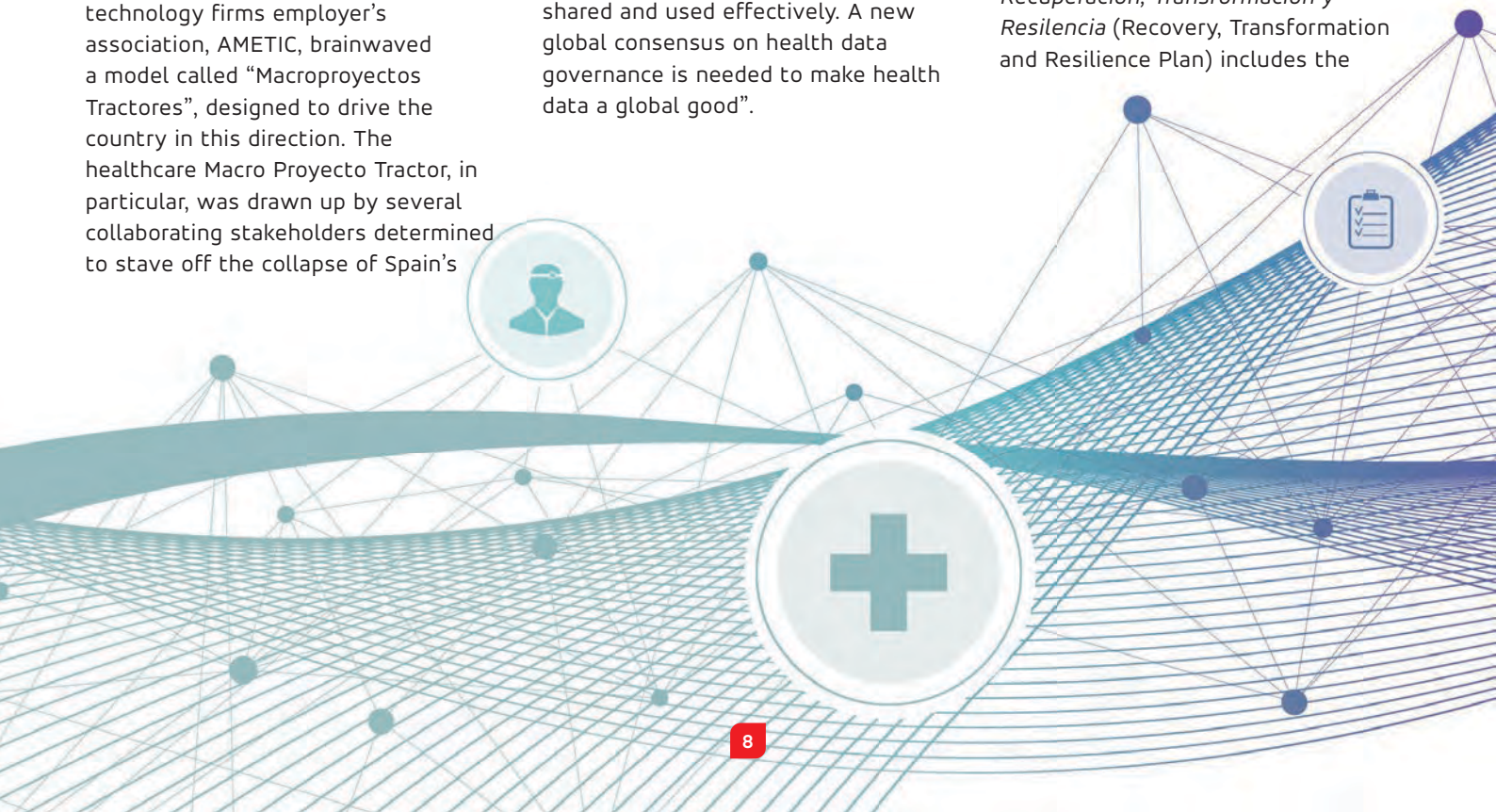
But while Cassandra voices have long been calling from the sustainability-ensuring overhaul of Spain's public health system, it wasn't until harsh reality brought it to the brink of collapse that any real steps were taken towards a new digital reality under the baton of technological innovation. Witness one of the main conclusions of the World Health Organization's Health Data Governance Summit held in June 2021: "The COVID-19 pandemic has produced large amounts of data and accelerated the trend towards digitalization in health. But to harness the full potential of data for better health outcomes data needs to be collected, shared and used effectively. A new global consensus on health data governance is needed to make health data a global good".

Crucial instruments

The European Commission has stepped up to the plate, providing its members with the Next Generation EU, an 800-billion-euro temporary recovery instrument recovery plan to support Europe's recovery from the coronavirus pandemic. This sum is to be spent primarily on the green digital transformation that is conducive to economic recovery. Over 50% will support research- and innovation-driven modernization under the Horizon Europe Program as well as the new health-promoting program EU4Health.

In Spain itself a digital agenda called España Digital 2025 has been set in motion, advocating an acceleration of the digitalization of the production model on the strength of the abovementioned digital-transformation proyectos tractores. One of the key aspects of this agenda is the call to strengthen Spain's cybersecurity-, artificial-intelligence and data-science capacity by 2025. It argues for the need to "move towards a data-based economy, guaranteeing privacy and harnessing artificial intelligence, to ensure that at least 25% of firms take it up within the next five years".

The Spanish government's *Plan de Recuperación, Transformación y Resilencia* (Recovery, Transformation and Resilience Plan) includes the



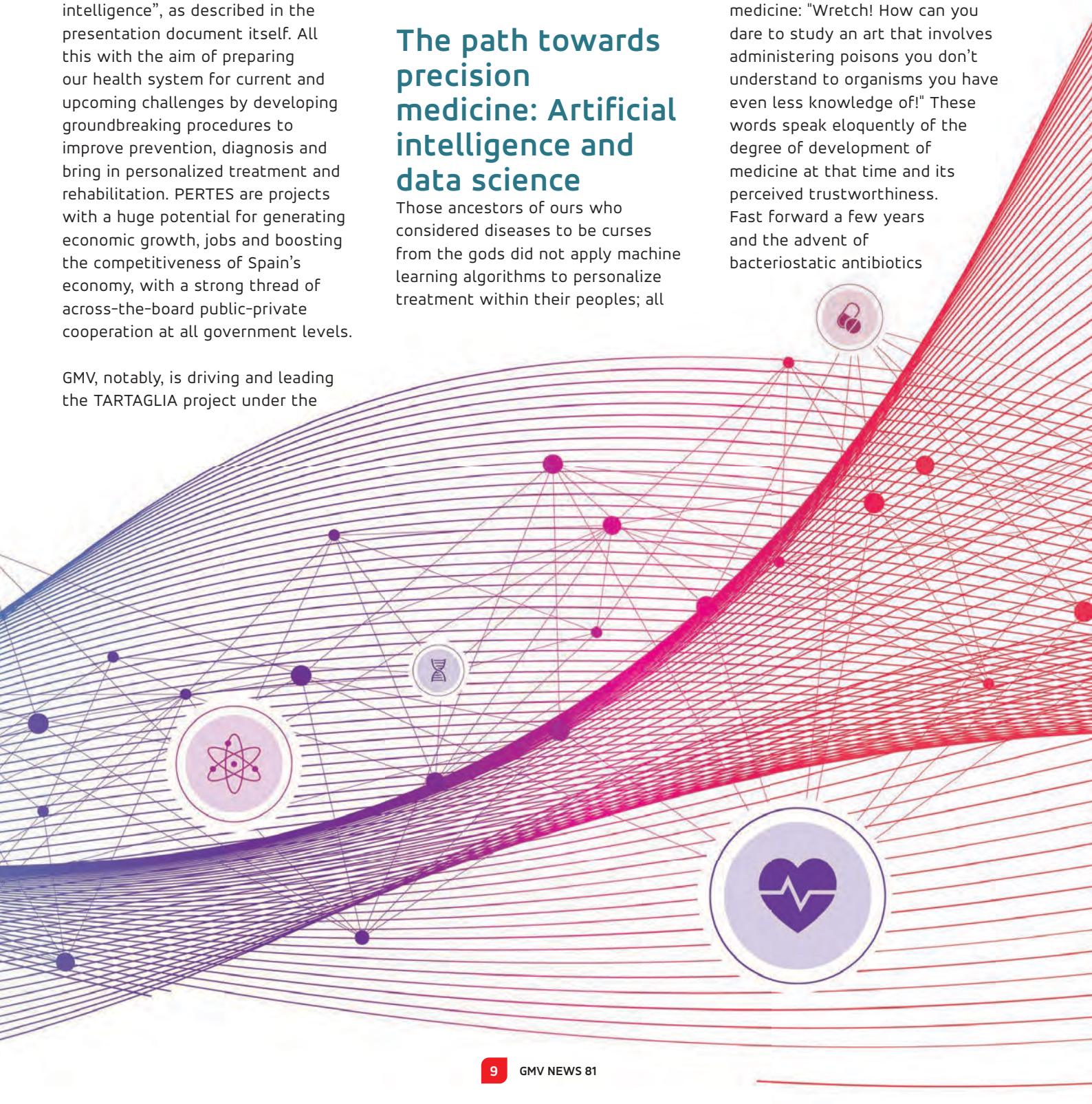
healthcare sector as one of its four main thrusts. This has spawned the *Salud de Vanguardia* (Cutting-Edge Health) project as one of the Strategic Economic-Transformation and Recovery Projects (*Proyecto Estratégico para la Recuperación y Transformación Económica*: PERTE). It seeks "a qualitative transformation of the sector in close association with science, innovation and the digital transformation" based on "precision medicine, advanced therapy medicinal products, data science and artificial intelligence", as described in the presentation document itself. All this with the aim of preparing our health system for current and upcoming challenges by developing groundbreaking procedures to improve prevention, diagnosis and bring in personalized treatment and rehabilitation. PERTES are projects with a huge potential for generating economic growth, jobs and boosting the competitiveness of Spain's economy, with a strong thread of across-the-board public-private cooperation at all government levels.

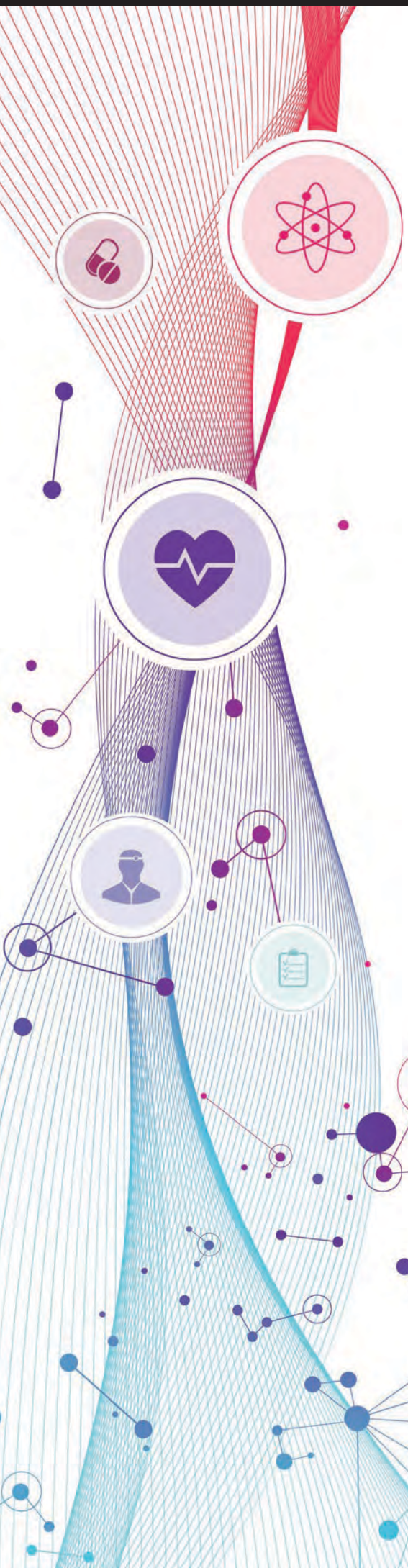
GMV, notably, is driving and leading the TARTAGLIA project under the artificial intelligence R&D missions program in Spain's Digital 2025 Agenda and the National Artificial intelligence Strategy. It has set up a consortium of 16 organizations with the aim of boosting progress in secure Federated Learning technology of artificial intelligence models, guaranteeing patient data privacy. Another goal is to obtain AI models to improve clinical practice in Alzheimer's disease, prostate cancer, diabetic retinopathy, complex chronicity and an ultrasound guidance aid system.

The path towards precision medicine: Artificial intelligence and data science

Those ancestors of ours who considered diseases to be curses from the gods did not apply machine learning algorithms to personalize treatment within their peoples; all these people were treated alike, using the same remedies applied by priests and medicine-men. The first evidence of drug use was in Mesopotamia, over four thousand years ago, without any apparent thought being given to possible side effects. Neither is there any sign of this in the first known prescriptions, medicine lists or inchoate pharmacopeia of Arab origin.

Come the Enlightenment and we find Voltaire speaking as follows to a nephew thinking of studying medicine: "Wretch! How can you dare to study an art that involves administering poisons you don't understand to organisms you have even less knowledge of!" These words speak eloquently of the degree of development of medicine at that time and its perceived trustworthiness. Fast forward a few years and the advent of bacteriostatic antibiotics





began to turn Voltaire's "poisons" into somewhat more efficient remedies, kick-starting the age of medication, according to the doctor, professor and pharmacologist Benigno Lorenzo Velázquez in his treatise "Therapeutics with its bases of experimental pharmacology.

After World War Two the pharmaceutic industry came under more orderly management, evolving towards today's model in which production goes hand in hand with product R&D for disease diagnosis, prevention and curation. Fruit of this R&D is the recent emergence of mass gene analysis bioinformatics technology, helping to produce millions of DNA sequences at an unprecedented speed. These breakthroughs have proven to be crucial in the diagnosis of inherited genetic diseases, with the identification of new genes and the advent of therapeutic disciplines like pharmacogenetics. This facilitated identification of the genetic profiles that determine each person's particular response to a specific medication, not only in terms of efficacy but also side effects. Precision medicine has been made possible by digital technology and also the development of solutions based on data science and more advanced prediction and diagnosis techniques.

Artificial intelligence (AI) has also enabled us to speed up the rate of clinical research, tapping into the huge volumes of top-quality data now available on the genetic and molecular traits of each patient, together with clinical, radiological and environmental, behavioral and socioeconomic data plus other health-relevant data. Factor in biomedical data too and it becomes all the more feasible to apply precision medicine, design more efficient medication with fewer side effects and help us to tackle the so-called "rare" or low incidence diseases.

The great challenge now, however, is to come up with great volumes of healthcare data, since one of the drawbacks of Machine Learning is the amount of information needed to train up an artificial intelligence algorithm. Their essentially confidential character means they are shielded by stringent security-guaranteeing legislation, differing from country to country. Proprietary organizations are hence somewhat loath to share this data for research purposes. Furthermore, as happens with rare diseases (incidence below 5 people per 10,000 inhabitants) or very rare diseases (incidence below 1 person per 50,000 inhabitants), it becomes necessary to carry out transnational research, pooling the critical mass of patient data from patients of different countries.

TARTAGLIA: a country-wide project to speed up healthcare research

GMV has been working for some years now on major EU projects like HARMONY and PIONEER to fast-track clinical and pharmacological research by mining huge volumes of healthcare data from a whole host of health institutions, pooled in a centralized Data Lake. The experience and expertise built up in these projects was the dealmaker in winning the company the TARTAGLIA R&D project, which aims to speed up

clinical and healthcare research using a new branch of machine learning, namely, federated learning, in which the AI algorithms are trained up collaboratively without the healthcare data ever leaving the hospital's datacenters. This is a paradigm switch in the way of working with machine learning techniques, based on centralized pre-processing data storage.

The task of extracting evidence from healthcare data, in order to improve clinical practice, is beset with stiff challenges. To start with, data privacy legislation tends to stem the flow of data from regulation-chary healthcare organizations. Secondly, such data as is forthcoming usually comes from a very small number of sources; this sows a bias into the AI algorithms, makes results less precise and much less generalizable.

To break down these barriers GMV will be applying advanced cryptography and secure distributed computing techniques to train up machine learning algorithms while keeping patient data in proprietary organizations' repositories. A federated network will be set up, with huge volumes of clinical data being managed by a choice set of health organizations, including Fundació ACE, La Fe Healthcare Research Institute (*Instituto de Investigación Sanitaria La Fe*: IIS La Fe) of Valencia Region; the Canary Island Healthcare Research Institute (*Fundación Canaria Instituto de Investigación Sanitaria de Canarias*); Valencia Region Biomedical and Healthcare Research Foundation (*Fundación para el Fomento de la Investigación Sanitaria y Biomédica de la Comunitat Valenciana*: FISABIO); the Galician Health Knowledge Management Agency (*Agencia Gallega para la Gestión del Conocimiento en Salud*: ACIS); Rioja Health Foundation (*Fundación Rioja Salud*); Universitari Vall d'Hebron Foundation (*Fundació Hospital Universitari Vall d'Hebron*: VHIR) and *Fundación TIC Salut Social* (TICSALUT). It also includes a public-private consortium of other leading companies and organizations in this matter; this consortium aims to turn TARTAGLIA into a country-wide project (*proyecto PAIS*) to help Spain become a provider of innovation and knowledge at the European level.

The 3-year, 9.1 million-euro TARTAGLIA project is being financed by the Ministry of Economic Affairs and Digital Transformation (*Ministerio de Asuntos Económicos y Transformación Digital*) with funds from the Recovery, Resilience and Transformation Plan (Next Generation EU funds).

Ana Céspedes

IAVI Chief Operating Officer

Ana Céspedes is a worldwide cynosure in the health sector, where she has held several high-level posts of general manager, marketing and strategy, prices and market access, communication and corporate affairs in organizations of the stature of Arthur Andersen, Serono Iberia, Merck KGaA and IAVI.

She currently works as Chief Operating Officer of the New-York-based IAVI. She holds a PhD in Pharmacy, executive graduate in general management and Business Innovation Certificate from MIT.

She collaborates in many initiatives with a broad social impact. She is cofounder of the Think Tank Spanish Women Leaders in Life Sciences, member of the Healthcare Consultancy Council of Madrid Open City, the Governing Board of IESE's Healthcare Chapter, the Science Council of Instituto Propatiens, Women in Business Council in the USA, ambassador of the initiative #LasMujeresnosMovemos and founder of Living Mindfulness.

IAVI, a nonprofit scientific research organization with public-private collaboration, was first set up in 1996 to find an AIDs remedy. What would you highlight as the trademark trait of this organization you run?

IAVI stands out above all for its scientific prowess, running top-level labs in California, New York, New Delhi and London. Another hallmark trait is its ability to run groundbreaking collaborations in the interests of fair access to any biomedical innovation. We feel especially proud of having successfully drawn on the technologies and expertise developed in our portfolio of HIV vaccines in order to make headway in the development of vaccines and antibodies against other infectious diseases that still stand in pressing need of such help. And especially of having done so in collaboration with organizations all around the world with whom we share an interest in worldwide health. We are now, for example, working with a Spanish company (Biofabri of the ZENDAL group) in the development of a TB vaccine.

To bring out fully what it means for a woman to be running such an important international organization like IAVI, please talk us through your life journey, from the moment your attention was first grabbed by biology and the world of infectious diseases.

My science career first really kicked off with a Pharmacy PhD from Madrid's Universidad Complutense. I then worked in posts of strategy, consultancy, marketing, product launches, market access and prices, communication, legislation, quality, Government Affairs in organizations like Arthur Andersen, Serono Iberia and Merck KGaA, initially in Europe and then, from 2012, at world level, based in Boston (Massachusetts, USA). During those years I cut my teeth in general management, strategy and innovation and technology in the Madrid business school IESE, London School of Economics and Massachusetts Institute of Technology (Boston). In 2018 I decided to switch to the private world of Big Pharma, to the world of Global Health, and I moved to New York, where I currently live. My post of Chief Operations Officer in IAVI, the organization I currently work for, ushered me into the world of infectious diseases. In IAVI I'm responsible for worldwide operations, including strategy and development, access and marketing, government relations and external relations, communication, operations in India and Africa, human resources, finances, administration and business technology. I'm lucky enough to be working with a wonderful team of top-level leaders. Excellent people too. In IAVI "how" is just important as "what". This makes me especially proud of our organization.

IAVI is a fine example of public-private collaboration. Indeed the main driving forces were the Rockefeller foundation and the Bill and Melinda Gates foundation, backed up by numerous governments. The current pandemic has had a salutary effect of speeding up public-private collaboration. What can you tell us about this? Do you expect this joint effort and shared will to continue into the future?

Public-private collaboration is crucial to the area of health promotion and prevention and infectious diseases in particular. This is so, because the problems are tremendously complex and the risk is too high for a single agent. The pharmaceutical industry is key, and the risk is so high that it needs to be shared with public agents and philanthropic organizations. The creation of IAVI in 1996 was a huge breakthrough. In the case of AIDS the Rockefeller Foundation and the Bill and Melinda Gates Foundation (BMGF) understood quite clearly from the start that developing an AIDS vaccine called for collaboration between the pharmaceutical industry and governments. The COVID-19 pandemic has confirmed anew that major worldwide health problems require public-private collaboration. The public-private alliances set up to develop COVID-19 vaccines have broken all speed records. As of today there are 23 COVID-19 vaccines. Access to innovation has not been even-handed, however. At the time of writing resource-poor countries have vaccination rates of only 13%, compared to 80% in resource-rich countries ([1]). There is certainly room for improvement here.

To confront the COVID-19 virus, FDA approved two monoclonal antibody treatments for emergency use: bamlanivimab and the casirivimab and inmdevimab antibody cocktail. Could you explain the difference between them and between the vaccines? And how long until we have a vaccine giving long-term immunity?

There has been great innovation in the area of monoclonal antibodies. Four products have been given FDA emergency use authorization (EUA) for slight-to-moderate COVID-19 treatment in non-hospitalized patients with a grave risk of passing on to serious illness or hospitalization. In one case also for pre-exposure prophylaxis. These are sotrovimab (GSK) in single treatment and, in combination, bamlanivimab and etesevimab (Lilly), casirivimab and imdevimab (Regeneron), tixagevimab and cilgavimab (AstraZeneca). These products differ mainly in the specific way they bind onto the various targets of the SARS-CoV-2 virus and hence their potential of neutralizing the various variants. There are further differences between their doses, the way they are administered and specific indications. In some cases efficacy drops off significantly against the Omicron variant; in other cases the efficacy holds pretty steady. Sadly, as monoclonal antibodies, they may be sidestepped by future variants.

The COVID-19 pandemic has confirmed anew that major worldwide health problems require public-private collaboration

As for the vaccines, there are still some big questions to be answered. These include the future evolution of the virus and its response to "vaccination pressure" as well as reservoir populations with a low vaccination level. It's too soon to tell if the situation will become flu-like, with annual jabs (or even more frequent if it turns out to be non-seasonal) or if, on the contrary, we achieve a longer-term protection, as achieved with other pathogens. COVID-19 vaccine innovation is focusing on the attempt to maintain efficacy against any variants and the weighing up of alternative means of administration that might offer viable protection against infection. We at IAVI are working on a candidate nasal-spray, viral-vector (replicating) COVID-19 vaccine; we hope this will induce immunity in the nose mucous, thus preventing SARS-CoV-2 from infecting cells at the first point of entry.

Has the fast-tracking of clinical tests and legislative approval represented a game-changer for the development of pharmaceutical products and drugs?
Up to 2020 the mean vaccine development time was 11.8 years. The mumps vaccine that been the previous record holder, and it took four years from the gathering of viral samples to its authorization in 1967. COVID-19 is a watershed moment in vaccine development. This was made possible by many factors: the huge outlay, efficient public-private collaboration and prioritization by governments, regulating authorities, research bodies and pharmaceutical companies around the whole world. That said, these crucial factors are not always in place and it is important to understand that other vaccines cannot be similarly fast-tracked. Take the example of tuberculosis (TB); three people die each minute from TB around the world, adding up to 1.5 million victims a year. And although there is no effective vaccine for adults, hardly 100 million dollars a year is spent on TB research around the world. This pales into insignificance compared to the 7 billion spent in a single year on COVID-19. A TB vaccine could save 15 million lives in 10 years.

IAVI has set up the IAVI DataSpace, a bioinformatic project that taps into the vast data pool of IAVI and its research partners to conduct pioneering HIV epidemiology studies

Could you share with us some examples of technologies IAVI is now working on like Big Data, machine learning and artificial intelligence in its vaccine research?
IAVI is working on several fronts to harness the power of big data. One example is the design of broadly HIV-neutralizing monoclonal antibodies using smart design strategies that involve computer design of proteins and bioinformatic information. The computer design approach uses Rosetta Commons to design leader protein constructions. These are then evaluated functionally in the lab by way of directed evolution and mutational scanning of "nnk" codons to design HIV envelope protein derivatives with unique binding properties to provoke, expand and drive responses of antibodies similar to known broadly HIV neutralizing antibodies. The bioinformatic analysis is used to analyze the large datasets generated from this library-enriching approach. Similar design approaches are used to optimize the monoclonal antibodies; this leads to large datasets that also need bioinformatics analysis.

On another front, with the support of the U.S. Agency for International Development (USAID) through the United States President's Emergency Plan for AIDS Relief (PEPFAR), IAVI has set up IAVI DataSpace. This is a bioinformatics project that pools the data compiled by IAVI and its research associates to carry out trailblazing HIV epidemiological studies. The project brings together a unique collection of clinical and immunological data plus the associated biological samples.

In the abovementioned project you have successfully obtained a sufficient sample for extracting clinical evidence thanks to the participation of patients' associations, academic institutions, hospitals, the pharmaceutical industry, regulators, evaluators and technology companies. Its many challenges include satisfying the constraints of the various regulations and ethical committees. Do you have any idea how to speed up the work in these two areas?
In the field of biomedical HIV prevention research we have seen that the formal clinical testing networks, such as the HIV Vaccine Trials Network (HVTN) and the Microbicide Trials Network (MTN), have been tremendously beneficial for making headway in the clinical evaluation of new biomedical prevention candidates. These are international, publically-financed collaboration networks that are deeply and respectfully linked to the communities that will eventually benefit from the research carried out. They boast a wealth of experience in all aspects of clinical research and have long liaised with regulators and ethics boards. Another factor we consider to be essential to speed up R&D work is for product developers to become involved with the communities and regulators in the very first stages of product development. It is essential to incorporate characteristics that promote product acceptability and availability from the very start of the research.

Personalized and precision medicine both face the same problem in terms of the curing of rare diseases, namely the problem of making developments profitable with a lower number of patients. It has in fact recently come to light that only 43% of medicines approved by the European Medicines Agency receive any funding, and take an average of two years to be included in Spain's public health system. Do you have any ideas how to close this worrying and access-barring breach?

Our health systems are geared towards disease treatment rather than health promotion. OECD countries spend only 2.8% (latest figures, 2017) of their health budget on prevention (44% of this sum is spent on the monitoring of the state of health). To make matters even worse, the prevention budget is always the first to suffer cuts. Spain lags even further behind here, spending only 1%([2]). An ageing population with a higher disease load means the room for innovation is increasingly cramped, even when the cost-effectiveness of any investment here has been clearly demonstrated. To my mind Next Generation funds should be spent on changing the disease-centered health system to a health-promoting one. This is something that private insurers and governments of other countries already have in their agenda. This would free up resources for opening up innovation to those who need it.

Our healthcare systems center on disease treatment rather than health promotion

(1) *(n.d.). Share of people who received at least one dose of COVID-19 vaccine. Our World in Data. Retrieved from: https://ourworldindata.org/grapher/share-people-vaccinated-covid?time=2020-12-01.latest&country=High%2Bincome~Upper%2Bmiddle%2Bincome~Lower%2Bmiddle%2Bincome~Low%2Bincome*

(2) *Bartres, O. (2021). Así 'Pilló' el covid al SNS: Por 100€ de Gasto sanitario, 1 a Salud Pública. Redacción Médica. Retrieved from: https://www.redaccionmedica.com/secciones/ministerio-sanidad/gasto-salud-publica-espana-1-gasto-sanitario-6993*

Spanish Navy tests Seeker UAS in Exercise FTX BRIMAR 21

The system turned out to be a vital asset in the campaign and allowed the Marine Infantry Brigade (*Brigada de Infantería de Marina*: BRIMAR) to locate targets both by day and night thanks to its dual payload with thermal and visible cameras, thus making a big contribution to the success of the exercises

The Marine Infantry Brigade (BRIMAR), a part of the *Tercio de Armada de Infantería de Marina* (Marine Infantry Protection Force), deployed its Seeker aircraft from December 9 to 13 at the San Gregorio national training center in Zaragoza, during the FTX-BRIMAR 21 maneuvers. The Seeker system was involved in these exercises under the RAPAZ program led by the Subdirectorate-General for Planning, Technology and Innovation of the Spain's Defence Ministry, which reports to Spain's Directorate General of Weapons and Material. The Seeker UAS proved a vital asset in the campaign, where intelligence gathering through threat identification, tracking vehicles and other targets, and assessing terrain, routes, and settlements is imperative.

In these particularly demanding live-fire exercises, the Seeker UAS demonstrated its capabilities. The BRIMAR troops were able to take full advantage of the system's autonomy and range to conduct operations from advantageous locations, even in very adverse weather conditions, with surface winds exceeding 40 knots, and to arrange autonomous takeoffs and landings in conditions providing little to zero visibility, including night flights. Despite the complex environment, the Seeker UAS was able to deploy smoothly and enabled the BRIMAR to locate targets both day and night thanks to its dual payload, complete with both a thermal and visible camera. This contributed to the success of the exercises.

During the exercises, the Seeker UAS processed available data sources to supplement the video with information of use to all deployed troops, not just the system operators: the video and data generated was distributed in real time to the BRIMAR control station using VidStream, a secure, high-quality, latency-free video and data transmission system. This was done using the new RF-7800H-MP radios from L3 Harris, which are natively integrated into VidStream. Thanks to this setup, the Seeker UAS was the only system to relay video from its ground position to the control station.

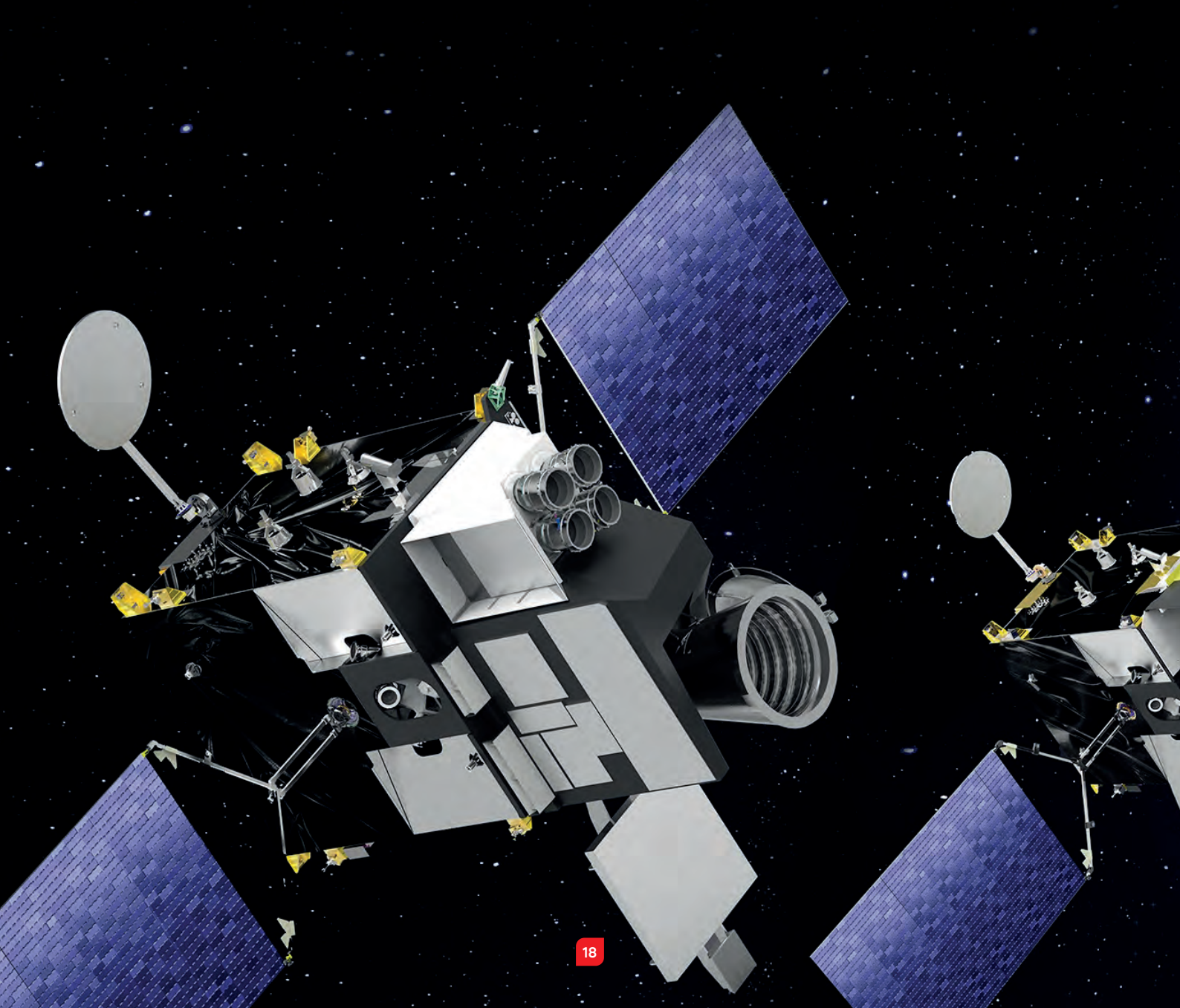
This UAV, developed and produced by GMV and Aurea Avionics, is currently one of the most efficient systems in the Class I Mini segment, with an endurance of 90 minutes, a range of 15 km and a weight of 3.5 kg. Both the Spanish Navy and the Spanish Army received the first Seeker UAS units to reinforce the intelligence, surveillance, and reconnaissance capabilities of the Marine Infantry Protection Force and the Spanish Army's "Almogávares" VI Paratrooper Brigade, two units that enjoy international prestige as elite forces.

Operational Optical Data Services for Meteosat Satellites

This service will be supporting flight dynamic operations of EUMETSAT's Meteosat satellite fleet (MSG and MTG)

GMV has been awarded a new contract by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), located in Darmstadt (Germany) for the provision of Operational Optical Data Services to support the flight dynamics operations of its fleet of Meteosat (MSG and MTG) satellites in GEO.

The main purpose of the service is the regular provision of high accuracy optical data and orbit determination solutions, fully integrated with the EUMETSAT operational environment, under



stringent accuracy and timeliness requirements. This information will support the orbit determination, manoeuvre estimation and ground station calibration operations at EUMETSAT and complement schedule or contingency station outages. The nominal duration of the contract is 3 years with 2 optional yearly extensions.

The optical data will be provided by the Polish 6ROADS network of telescopes, which has already worked along with GMV in several ESA and CNES projects and contribute regularly with optical data to the EU SST system. 6ROADS counts on a global network of telescopes in Poland, Italy, Spain, Namibia, USA, Chile and Japan.

The data curation, orbit determination and manoeuvre estimation operations will be performed by GMV making use of its ***sstod*** software. This highly performant, multipurpose and state-of-the-art software is operationally used in a large number of systems including the Spanish, Polish and Romanian Operations Centres contributing to the EU SST, the Spanish military SST Operations Centre (COVE), the GMV's ***Focusoc*** commercial operations centre and the ArianeGroup's GEOTracker system, among others.

With this new service, GMV strengthens its strong commitment with EUMETSAT, being one of its main providers of ground segment software infrastructure. This includes the complete ground control segments of Metop-SG and MTG, plus the control centers and flight-dynamic systems of Metop, Sentinel-3 and Sentinel-6. This new contract also reinforces the position of GMV as the most relevant provider of Flight Dynamics technology and the main industrial player in the Space Surveillance and Tracking in Europe.

GSAW 2022

GMV took part in the 26th Ground System Architectures Workshop (GSAW 2022) under the banner theme "Driving Innovation for Enterprise Integration", held online from 23 February to 3 March.

The workshop included an exhibition area where GMV displayed its range of satellite control products. GMV also took part in a paper called: "There and back again: ground software for large constellations of small satellites".

GSAW's range of presentations, work groups, discussion panels and tutorials provides an excellent forum for experts, users, developers and researchers in aircraft ground systems to put their heads together and swap notes.

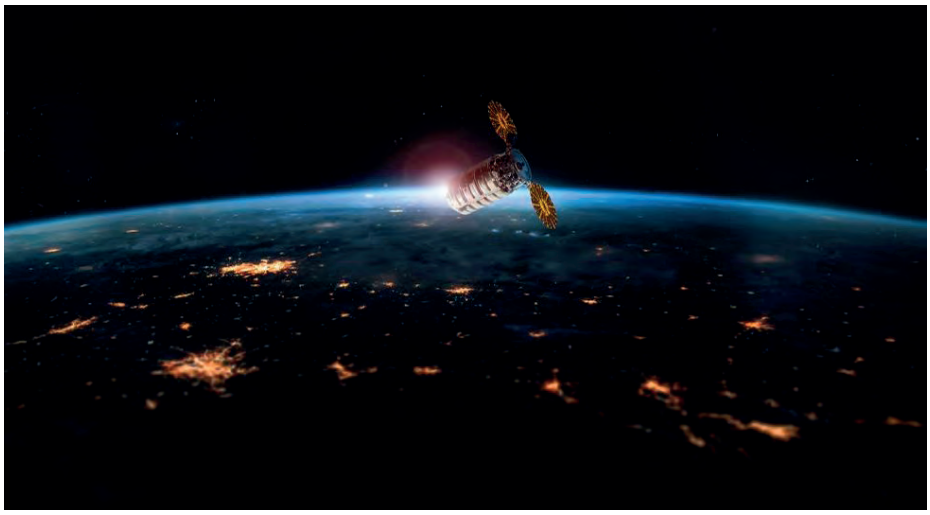
GOVSATCOM 2022

GMV ran a stand at GOVSATCOM, EU's yearly defense and security conference, held this year in Luxembourg on 24 February.

Satellite communications have become crucial components for defense, security, emergency-response, humanitarian-tasks and diplomatic setups operating in remote and bleak environments with little or non-existent infrastructure, where global connectivity really comes into its own.

GOVSATCOM has by now become a must for all international SATCOM agents in the satellite, government, institutional and defense ambit. It represents a new collaboration arrangement not only between military and civil stakeholders but also with the industry to help boost Europe's competitiveness in this field.

GMV spearheads new paradigm for Space Vehicle Control Technologies



GMV continues to push forward innovative Guidance Navigation and Control techniques, processes and methodologies for space vehicles.

Traditionally, autonomous operations are often restricted to minimal scope in order to minimize the impact of a very costly traditional validation and verification processes. However, higher levels of on-board autonomy through embedded, on-board optimization-based systems are required for a new generation of space missions and applications.

GMV in Portugal has been awarded a contract by ESA to lead a consortium into advancing the state of the art towards a dependable, comprehensive, cost-effective, and qualified process for the verification and validation of embedded optimization software in space.

VV4RTOS, "Verification and Validation of Real-Time Optimised Safety-Critical GNC SW Systems" will update existing frameworks and processes to prove that these algorithms can fly safely, reliably and efficiency on space-grade avionics, by guaranteeing safe code execution under resource and timing constraints.

The outputs will then be materialized in a set of tools and framework and its application to a number of benchmark cases, such as in-orbit servicing and launch-vehicle recovery.

In the launch-vehicle domain, the team will be developing, in parallel, through a second contract with ESA, optimization-based autonomous controls application.

Guiding a launcher vehicle through its trajectories to place payloads in orbit, by vectoring the direction of thrust of multiple rocket engines, is a key enabler for a new generation of small affordable, launchers that can be reused frequently, with short turnaround times.

A Fault Detection, Isolation and Recovery for the flight software that ensures mission safety and success even in case of failures in some of the engines l will be the focus of activity "Fault Tolerant Control for Clusters of Rocket Engines".

Its outcome will be the definition a Guidance and Control system that enables effective detection of failures, and to put in place autonomous trajectory replanning to ensure that the vehicle's stability and performance boundaries remain satisfied.

ESA shows its ongoing trust in GMV's mission planning systems

The European Space Agency (ESA) awards GMV the operations- and maintenance-contract of the Sentinel-1 and Sentinel-2 mission-planning systems

GMV is playing a key role in the Copernicus program, busily participating in various projects for both the ground and space segment. During launches it also provides support services for the mission planning and control systems.

As part of these ongoing activities, since 2013 GMV has been responsible for maintenance and operation of the Sentinel-1 mission. The European Space Agency (ESA) has recently upped this already-high level of responsibility, awarding GMV the Mission Planning System maintenance and operations contract both for Sentinel-1 and Sentinel-2.

This new contract takes in 4 main activities:

Operations: GMV will be responsible for plan generation of the pair of Sentinel-1 satellites and the pair of Sentinel-2 satellites. This activity includes not only the Sentinel-1 emergency service, on watch during weekends and non-working days to deal with any natural disasters, as recently occurred with the volcanic eruption and ensuring tsunami in Tonga, but also operation of the ground antennae coordination system and the European Data Relay System (EDRS).

Maintenance: GMV will be responsible for corrective and perfective maintenance of the above mission's planning systems as well as their auxiliary tools.

Infrastructure: GMV will also be responsible for designing necessary mission-planning-system host infrastructure. This will involve adding to GMV's datacenter an area dedicated to this activity. This infrastructure will be complemented by cloud-hosted auxiliary data-circulation and -storage systems. Both systems will be under 24-hour-a-day, 365-day-a-year monitoring to ensure complete availability.

Lastly, new tools will be developed to improve and optimize operations of both missions and studies will be conducted to prepare the systems for the follow-on C and D units to replace the current ones at the end of their operational life.

This new contract shows ESA's ongoing trust in GMV's mission planning systems and ratifies its satisfaction in the work carried out in past years.

DLT applied to satellite communications

BlockSatCom, a project aimed at researching secure communications technology in the space industry, has recently been launched. GMV is leading the project's business consortium, which also includes Guardtime (Estonia) and VdA (Portugal).

The purpose of this consortium is to study and develop new architectures to solve current problems or give satellite communication systems new capabilities through distributed ledger technology (DLT), drawing on use cases that have been reviewed and shared among various members of the satellite industry and the DLT world.

The key advantage of DLT, which has so far been used in the field of cryptocurrencies, is that it provides greater information transparency and security thanks to the decentralized storage and use of systems' data.

This project will explore the benefits that this technology can bring to the satellite telecommunications industry. In addition, it will identify potential use cases, defining the best-suited

system architectures and the required technological developments. The project also plans to keep the user community informed of its progress and findings.

This groundbreaking project falls within the European Space Agency's (ESA) Telecom ARTES 4.0 program. GMV is responsible for coordinating the project execution phases as well as liaising with ESA and the consortium members and stakeholders, including companies in the space industry and experts in DLT-based systems.

BlockSatCom is currently in the requirements definition phase based on end-user perspectives.

IDEIA Conference 2022

GMV was present at the IDEIA 2022 conference, held at Escola Naval, in Almada, Portugal. This banner theme was “Relevance of Space for maritime operations and the blue economy”, and addressed the generation of insights, not only presenting solutions, but also identifying concrete problems that can be solved using innovation and technology and fostering network collaboration.

Teresa Ferreira, General Manager of GMV´s Aerospace sector in Portugal, moderated a panel on “Emerging space capabilities for maritime safety and security” and José Neves, General Manager of GMV´s Defense and Security sector in Portugal, participated in the debate on the “National Strategy for Space and National Defense”.

The opening session of the conference “IDEIA 2022” was attended by the Chief of Staff of the Army, Admiral Henrique Gouveia e Melo, who in the opening address argued that In a globalized society, where volatility and unpredictability are constants of international relations, only a forward-looking, intelligent and adapted posture can serve national interests. “My ambition as Chief of Staff of the Army is to provide Portugal and the Portuguese people with a modern Navy. A Navy that operates and makes use of the five domains: sea, land, air, space and cyberspace.

Innovation will only be achieved if a highly hierarchical, typically military, structure and more unstructured communities of knowledge and interests can coexist in harmony. These communities will be the real engine of evolution, inducing an attitude of change and constant adaptation within the institution. The association of internal communities with external entities linked to science and research is central to the entire innovation process. This connection must be strongly encouraged through protocols and partnerships, which will also contribute to the solidification of a national naval technological-scientific-economic cluster.

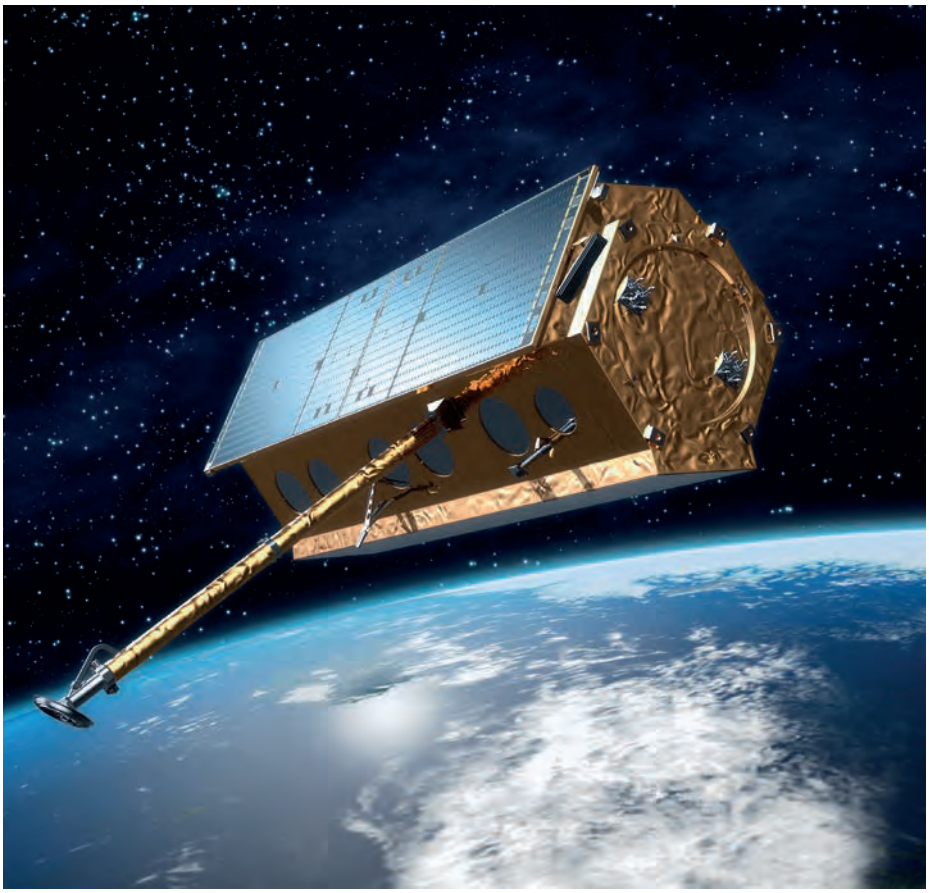
GMV guarantees PAZ satellite services

GMV, the world's number-one independent supplier of telecommunication satellite control centers and responsible for designing, developing, validating, and implementing the control center and user services included in the ground segment of the PAZ satellite, has signed a new contract with INTA (*Instituto Nacional de Técnica Aeroespacial*) for the corrective maintenance of the main elements of its ground segment.

The Spanish Paz satellite, with an estimated useful life of seven years, is a dual-use (civil/military) Earth observation satellite in orbit at an altitude of 514 kilometers over the poles and designed for surveillance applications, high-resolution mapping, border control, tactical support in foreign missions, crisis and risk management, natural disaster assessment, environmental control, and maritime environment monitoring.

This satellite is part of the National Earth Observation Program (PNOT) created by the Ministry of Defense and the then Ministry of Industry, Commerce and Tourism of Spain in 2007. Launched in 2018, it brought Spain into the space technology orbit and had GMV as supplier of the mission control center, including all aspects of platform planning and image acquisition, orbital control and satellite pointing and management and monitoring of onboard equipment and communications. GMV was also supplier of the user management and radar image distribution system.

The recently signed new contract, which covers the 2022-2023 period, includes corrective maintenance of the main elements of the ground segment, including the flight dynamics system (FDS), the mission control system (MCS), the mission planning system (MPF), and the user services (MUS).



SmallSat Symposium: defining what's to come

From 8 to 10 February the seventh annual SmallSat symposium was held in hybrid format in Silicon Valley, Mountain View, California.

Under the banner theme "Defining what's to come for the smallsat industry", the event brought together speakers from public, private and governmental consortia to pinpoint critical trends and weigh up innovative technology. The idea is to create an ideal environment for open communication, generation of contacts and critical analysis.

The agenda covered several themes, ranging from the market and legislative issues to emerging technologies and concepts such as IoT, orbit repairs, mega-constellations, machine learning and Cloud Computing, among others.

GMV, a world leader in satellite ground control systems, could hardly be missing from this conference. It also ran a stand showcasing its product lines for satellite control (***Hifly***), flight dynamic operations (***Focussuite***), mission planning (***Flexplan***), ground station control and monitoring (***Magnet***) and payload management (***Smart payload***).

GMV collaborates with UKSA on active space-debris removal missions

With more than 30,000 regularly tracked non-operational space debris objects in orbit around the Earth, the task of removing the debris safely is of critical importance to ensure the safety of essential national infrastructures and services which rely on satellites, such as navigation, telecommunications and weather forecasting.

The UK Space Agency (UKSA) is currently funding three parallel Phase 0-A mission studies to investigate the removal of two uncooperative, defunct UK-owned satellites from Low Earth Orbit (LEO) and to prepare for a future in-orbit servicing mission. Consortia led by SSTL, Swiss start-up ClearSpace and Astroscale were selected and awarded just under £1 million between them to complete the early-phase studies by the end of March 2022, with a launch date planned for 2025.

The subsidiary of GMV en UK, GMV NSL, are participating in the SSTL-led study, LEOPARD (Low Earth Orbit Pursuit for Active Removal of Debris), alongside Airbus Defence and Space, NORSS, The Satellite Applications Catapult, University of Lincoln, University of Surrey and ClearSpace. In LEOPARD, GMV NSL are the subsystem provider for the Guidance, Navigation & Control (GNC) for the highly complex Close Approach phase, including analysing and proposing a GNC sensor payload for the mission. In the Phase 0-A, GMV NSL have been supporting the design of the mission, performing trade-off studies in key areas and collaborating with our partners to define and evaluate concepts and to define mission requirements.

The Close Approach phase of the mission presents a substantial engineering challenge in the development of a robust on-board GNC to first approach the target from several kilometres down-range, perform critical inspections to characterise the object in detail to determine the orientation, spin rate and axis of rotation as well as the physical condition (broken appendages, surface material condition) and then perform capture using the selected capture technology. To achieve this, GMV are leveraging our extensive heritage in this area to define a highly autonomous and capable vision-based solution.

UKSEDS 2022

GMV NSL ran a stand at the 34th UKSEDS (UK Students for the Exploration and Development of Space), held in London's King's College on 5 and 6 March.

UKSEDS is a society that supports and educates youngsters and inspires them to take up an interest in space research and exploration. It organizes a host of initiatives under the umbrella, worldwide organization SEDS, a space association targeting youngsters and operating in different parts of the world through a network of offices in countries like Canada, Mexico, Nepal, Spain and the United States.

Organized this year by UKSEDS and KCL Space, the event this year will consist of chats by leading figures from the space industry. There will also be a job fair and a whole range of debates and activities open to all participants.

GMV joins Net Zero Space initiative to eliminate space debris

The space environment is becoming increasingly polluted due to the proliferation of objects orbiting in an uncontrolled manner around the earth, particularly in low and geostationary orbits (the most interesting for use and exploitation). Estimates suggest that there are more than one million objects larger than 1 cm capable of causing potential damage of various kinds, and the number is increasing at a dangerous rate. To ensure a sustainable use of space, various key players in the space industry, including GMV, have launched the international initiative called Net Zero Space.

The platform brings together stakeholders from within the value chain of any type of space mission: satellite launchers, manufacturers, operators, civil society, research and academic organizations, space agencies, and public actors from all over the world. This coalition is pressing for an urgent and consensual response to the issue of rising orbital pollution and is calling for immediate and specific action to be taken to reduce it by 2030. GMV has pledged to improve and promote the use of its collision avoidance services and to continue developing new solutions to ensure the safety and sustainability of space operations.

Space is a shared asset offering major opportunities and services as well as significant social, economic, scientific and strategic benefits for all humanity. Everyday technologies such as telecommunications, resource observation and location, and financial transactions depend on space infrastructure, and therefore on the long-term viability of the Earth's orbital environment. With the space market expected to generate a turnover of more than $1 trillion by 2030, according to Bank of America's forecasts, space is becoming a tremendously important part of our economy. However, these benefits will only be possible if all market players come to an agreement on the long-term, safe, and sustainable use of space.

The members of the international Net Zero Space initiative share the view that this goal can only be achieved through cooperation, bringing together the private sector, civil society, research and academia, as well as public authorities and regulators. All those operating in orbit or supporting space operations on the ground have a key role to play in this endeavour.

GMV at Satellite 2022

For yet another year, Satellite, the world's top satellite-communications event, once more brought together in Washington representatives from the business world, government organizations and commercial clients to look at the future steps for the satellite industry. GMV was one of the 300+ exhibitors and 260+ speakers among the space market's crème de la crème.

Nowadays, sectors like telecommunications, finance, transport and even the consumer industry, among others, depend on satellites. Satellite 2022 showcases the market's most trailblazing solutions, designed to come up with an answer to stiff challenges like closing the digital divide, boosting space access, encouraging leadership and innovation and collaborating in the development of sector policies, among other issues.

GMV ran a stand to display its whole range of operational space-mission-ground-segment solutions including ***Hifly*** (satellite control), Focussuite (orbit control), ***Closeap/ Focusoc*** (collision avoidance and associated services), ***Flexplan*** (satellite-resource planning system), ***Magnet*** (monitoring and reception station control), ***Smartrings*** (configuration management) and ***Smarthz*** (payload optimization); as well as the necessary network security services (cybersecurity) and vulnerability-analysis services.

GMV improves handheld devices positioning

A consortium led by GMV has been selected by ESA for supplying a testbed reflecting handheld devices such as smartphones and tablets in order to develop and test novel algorithms able to detect and mitigate several threats such as multipath, interference and spoofing via exploitation of multiple antennas and Inertial Measurements Units.

With the generalization of handheld devices, applications closely linked to the use of GNSS in these same devices require a continuous improvement of positioning accuracy and robustness, which can be a challenge in urban environments due to multipath and signal blockage. These signal impairments cause substantial errors in the user position, undermining the correct functioning of the proposed applications. On top of these issues, there is an increasing number of both intentional and unintentional threats, such as spoofing or near-band interference. These threats can cause a significant degradation, making it impossible to satisfy the requirements of the ever more demanding GNSS applications present in handheld devices. In order to achieve the intended performance, different strategies, technologies and algorithms need to be put in place, as no single solution alone is able to cope with all these challenges.

The outputs of this project are twofold. On one hand to implement multiple algorithms in order to mitigate the harmful effects of multipath, interference and spoofing while providing an improved situational awareness. To this end, multiple antennas will be exploited to improve receiver performance tackling the multipath issue by making the best use of the spatial diversity, well-known geometry and radiation properties of the equipment. The antenna array will also be key for detection and mitigation of interference as well as providing spoofing robustness, all this through innovative algorithms. Furthermore, the consortium will explore the use of in-built sensors to calibrate the antenna array and increase receiver robustness to short signal blockages.

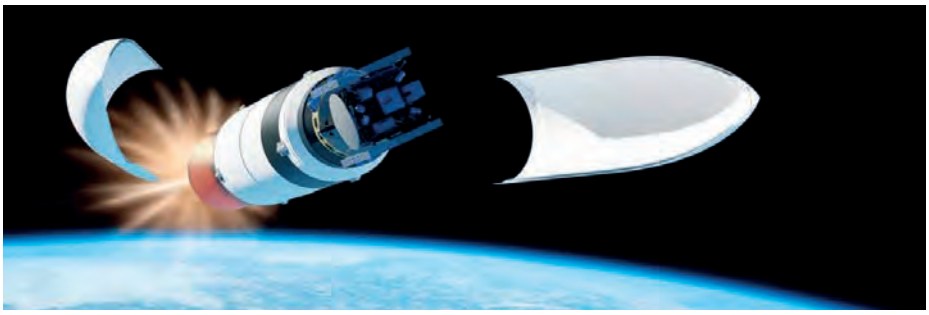
GMV will also develop a testbed representative of handheld devices and integrate the most promising innovative techniques therein in order to assess their performance and demonstrate potential improvement.

Recurrent space flight technology

Launches today need several months' preparation for a single payload delivery; this means a high recurrent cost for each mission. Launch manufacturers and operators have to carry out an exhaustive set of activities for each launch. These activities prepare the launcher for each specific mission, bearing in mind the cargo to be launched, the final orbit targeted and the trajectory to reach it. The mission configuration process involves inter-disciplinary interactions: pathway; guidance, navigation and control (GNC) system; propulsion; structures; software, etc.

The upshot is an unwieldy and time-consuming integration process that might take several months for each flight. The recurrent space-mission preparation costs, moreover, do not tend to fall as the number of launches rises; neither do they depend much on launcher size.

To help solve this problem ESA has awarded GMV a project for harnessing advanced guidance and control (G&C) design techniques and assessing available tools to facilitate automation of the algorithm reconfiguration process for different missions.



Application of these new solutions will mean less reconfiguration effort and shorter launch deadlines, while at the same time boosting operational availability and security. The activity focuses on mission adaptation challenges faced by real-world launch service providers.

As part of this activity GMV will be carrying out a critical review of the missions' whole preparation-, execution- and GNC-validation-process, in order to identify the main cost- and deadline-factors, then breaking them down into inevitable and malleable. This review will identify any leeway for mission-preparation improvements.

The project is expected to deal directly with the challenges faced by launch service providers in the real world, including reusable launch vehicles, space tourism launchers and microlaunchers.

Enhancement of earth observation satellites' global emissions inventory

On March 4, the kick-off event of the World Emission project, funded by the European Space Agency, took place as part of the EO Science for Society initiative. GMV is leading the business consortium that will develop this project with the aim of improving the global emissions inventory service extracted from earth observation satellite data.

Emission inventories provide essential information on the emission of pollutants or greenhouse gases into the atmosphere, such as their magnitude, the type of activity they originate from, their changes over time, and spatial coverage. These inventories are created to provide qualified scientific information on a regular basis to governments, subsidiary bodies, and policymakers to assess the progress of emission reduction measures and to decide on future strategies. These inventories are also used as input in scientific models at different geographic scales.

The World Emission consortium is made up of the industrial entities GMV, Capgemini and Kayrros, the Climate and Environmental Sciences Laboratory of the Pierre Simon Laplace Institute, the Max Planck Institute of Chemistry, the Free University of Brussels, the Cyprus Institute and the National Supercomputing Center (BSC). In addition, it has the support of the Free University of Amsterdam.

Over the project's 24-month duration, existing inventories and the quality of the algorithms used will be evaluated to expand the range of gases emitted and emission sources, as well as the geographic areas monitored, in close collaboration with end-user organizations. Work will be done to improve recording algorithms and increase the spatial and temporal resolution of the inventories.

OPS Industry Day

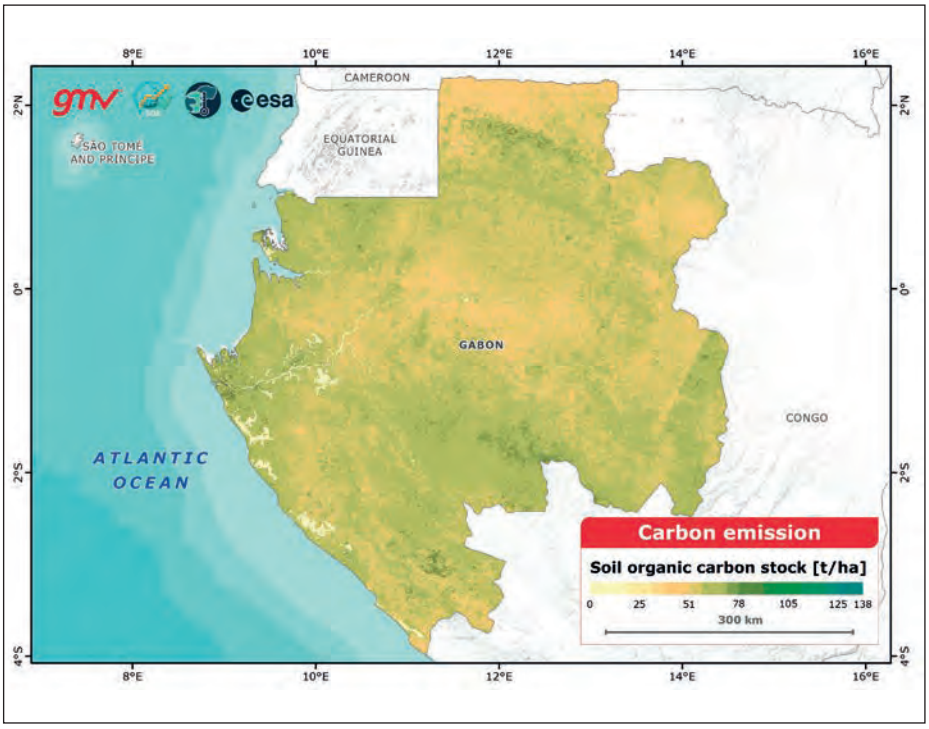
On February 22nd took place the 2nd OPS Industry Day, a virtual workshop organized by the European Space Agency's Operations Directorate.

The purpose of this virtual gathering was to compile industry needs for future activities in ESA programs (GSTP, ARTES, S2P, etc.). These activities were carried out jointly in work sessions during the workshop. Each work session exchanged ideas on subject-specific activities such as Optical Communications & RADAR, Flight Dynamics & Navigation – GNSS, Mission Operation and Ground Data Systems, Automation & Artificial Intelligence, Telepresence & Robotics Digitalisation & Cybersecurity, Space and Earth Environmental Protection – European Green Deal and Space Safety Competitiveness Projects.

GMV took part in this virtual workshop participating in the round table Automation and AI in Mission Operations. The session focused on applying both automation and artificial intelligence to things that add value, thus making it easier to adopt. In addition, GMV participated in the Virtual Exhibition with a stand to explain its wide range of expertise in satellite operations and its supporting data systems.

GMV leads ESA's GDA climate resilience project

The European Space Agency's Global Development Assistance (GDA) program has the long-term aim of systematizing across-the-board use of earth-observation information in international development-aid projects led by international finance institutions (IFIs). These institutions provide developing countries with financing and technical consultancy to drive their development. In pursuit of this long-term aim ESA has signed an agreement with the World Bank and Asian Development Bank in a new joint initiative called "Space in support of International Development Assistance", shortened to SpaceforIDA.



The GDA program covers a wide range of thematic sectors, including urban sustainability; climate resilience; fragility, conflict and security; marine environment and the blue economy; agriculture; water resources and clean energy. These are the key development priorities pinpointed by the IFIs; they also represent domains in which satellite data might have a big impact.

GMV is leading ESA's GDA Climate Resilience cluster. During this 18-month project GMV and its partners will be collaborating with the bank's regional operation teams that are promoting climate resilience and climate-change-adaptation measures within their respective sectors and also with global programmatic strategy units to facilitate takeup of satellite-based earth-observation climate services and guarantee their long-term sustainability.

In the GDA Climate Resilience project GMV will be using earth observation services for climate change resilience as developed in the ***Eoclima*** product to meet climate information needs of the teams of the World Bank and Asian Development Bank. ***Eoclima*** includes evaluation and monitoring of climate change risks, support for climate-change-adaptation measures and the contribution towards combined mitigation and adaptation solutions in land-management policies and forestry legislation.

WIA-E and STEM education in Europe

On 16 February the Madrid group of Women in Aerospace Europe (WIA-E) hosted the online event "Encouraging STEM and Space careers among the young" to coincide with the International Day of Women and Girls in Science.

WIA-E, in line with its overarching mission of promoting the visibility and leadership of women in the aerospace sector, held this online event to highlight the current situation of STEM career education (STEM = Science, Technology, Engineering and Mathematics). GMV, a WIA-E member, joined in this initiative to encourage an interest in STEM subjects, especially by girls.

The event kicked off with presentation of the official report "STEM Education in Europe", a research project coordinated by WIA-E with a contribution from GMV. This study offers an overview of the current state of STEM education. The session also tackled the main problems faced by these disciplines and effective mitigation strategies, in homes, schools and companies.

GMV also moderated and took part in the subsequent debriefing, with representatives from industry and academia plus social psychologists to debate the main points brought out in the panel discussion.

GMV applies robotic technology to prospecting and mapping the moon

Moon-RISE (Moon Robotic InSpEction), carried out for the UK Space Agency (UKSA), is bringing in autonomous surveying by means of a rover, robotic arm and the necessary instrumentation for carrying out these tasks

Some of the most recent missions to the surface of the Moon have discovered evidence of water and other potential resources that can support sustainable human exploration.

To identify and characterize the potential of these resources GMV NSL is working on a project for the UK Space Agency (UKSA), aimed at developing a robotic platform capable of autonomously surveying and mapping the moon.

Moon-RISE (Moon Robotic InSpEction), as the project is called, uses the concept of autonomous surveying with a mobile robot, a robotic arm, and the appropriate instrumentation to carry out these tasks.

The robot will use a combination of cameras and LIDAR for mapping during exploration and a Laser Induced Breakdown Spectrometer (LIBS) will be used to analyze mineral composition.

The platform will demonstrate navigation, mapping,and surveying in both surface and underground mines, as an analog to lunar lava tube caves, which are a primary subject of future exploration missions.

The project has now reached the preliminary design phase, and field trials are scheduled to be completed in the coming months culminating in a demonstration of the robotic platform and its operation in a manner similar to a mission to the Moon at Holmans Mine in Troon, Cornwall, UK.

Using autonomous robotic platforms in space opens up endless possibilities in the field of space exploration because by closing the decision-making loop onboard, these platforms can accomplish mission objectives more safely and quickly than if they had to communicate with the ground to make decisions and can address objectives that arise during their operations.

Moon-RISE is yet another example of GMV's knowledge and experience in robotic autonomy technologies for future deployment in space exploration.

GMV's 2020 EDIDP projects kick off

In these projects GMV is developing capabilities in artificial intelligence, command and control, guidance navigation and control, space and cyberdefense

December saw the official kickoff of AI4DEF, eCOLORSS, FIRES, ODINsEYE, INTEGRAL, SAURON and SEANICE, seven second-call EDIDP projects in which GMV is developing capabilities of artificial intelligence, command and control, guidance, navigation and control, space and cyberdefense.

AI4DEF's remit is to develop and demonstrate capabilities for the use of artificial intelligence in defense. Under this project GMV is responsible for defining artificial intelligence standards for application to defense. It is also coordinating one of the use cases for employment of artificial intelligence techniques to facilitate intelligence, surveillance and reconnaissance tasks.

FIRES and eCOLORSS are working on Europe's solution for obtaining superiority of next-generation artillery systems involved in European missions, based on common technological solutions. They correspond to two PESCO projects: Material and Components for Technological EU Competitiveness (MAC-EU) and Euroartillery. The aim of both projects is to maximize synergies on the strength

of innovation in shared components to optimize lifecycle costs and achieve EU independence in this domain. GMV's FIRES activity centers on definition of system architecture and operations concepts in the GNC feasibility study. As for eCOLORSS, as well as priming the project, GMV is also leading definition of architecture, feasibility analysis and system design, with a special focus on command and control, positioning, navigation and timing.

GMV's Portugal office is playing a key role too in SEANICE, part and parcel of PESCO MUSAS (Permanent Structured Cooperation Maritime Unmanned Anti-Submarine System), led by Portugal. A development program will be drawn up to link together all the selected platforms, assets, sensors, distributed systems and effectors for exchanging data and sharing information, promoting an innovating environment to cater for multi-vendor unmanned platforms with advanced processing functions. This approach will be conducive to a wide-ranging catalogue of accredited services made available in a way similar to App stores, in the interests of boosting operational capability, flexibility and cost efficiency in development, updating and C3 system support.

SAURON and INTEGRAL, for their part, are two projects that aim to improve our situational awareness in space and during space activities, doing so from a defense and security viewpoint. SAURON targets the design and prototyping of the necessary sensors and processing capabilities for identification and characterization of satellites and the design and prototyping of command and control systems for space activities. ODIN's EYE is geared towards the design of space missions for early-warning of ballistic-missile launches. GMV's activity covers several areas including the ground control segment, space surveillance and storage and broadcasting of sensor information.

EDIDP aims to support EU defense industry's equipment and technology-development efforts under co-funding of the European Commission. Designed to boost the EU's defense industry competitiveness, these projects will help to strengthen the EU's strategic autonomy.

In all, under two EDIDP calls, GMV is participating in 11 projects, making it the company with the fifth biggest number of projects.

GMV looks into defense forces' hybrid warfare needs

Under CLAUDIA (Cloud Intelligence for decision making support and analysis) a four-year framework contract signed with the European Defense Agency (EDA) in 2019 for developing a dedicated Modular Software Analysis platform (SWAN), GMV has now won two follow-on contracts to extend capabilities even further.

CLAUDIA's main aim is to study the possibilities of using cloud intelligence in the analysis and evaluation of military theaters, focusing on hybrid warfare, doing so by means of an extensive analysis and processing of the various data involved. This platform will be using technology like cloud hosting and storage, artificial intelligence (AI) and other big data tools with the aim of meeting defense forces' hybrid warfare needs, where they are operating in high-mobility, high-threat scenarios.

During the first two years activities will center on the development and rollout of cloud infrastructure, tactical cloud concepts and distributed simulation. Following on from this work, the new developments now awarded will be based on application of the Internet of Things (IoT) concept in the military environment (Internet of Military Things IoMT) and the development of a wargaming proof of concept in hybrid warfare scenarios.

The idea is to extend tactical cloud infrastructure capabilities (proven in former contracts) introducing several sensors of diverse types to tap into available virtualization in order to boost operational effectiveness and efficiency. A study of IoMT pros, cons and challenges will also be carried out (information security, communications, etc).

A proof of concept will also be drawn up to extend SWAN simulation capacities, including a wargaming tool that includes a simplified hybrid warfare model to provide for interactive simulations on the basis of pre-set scenarios. This will enable analyses of these scenarios to be conducted for training or research purposes.

Biomedical and biotechnological engineering for defense and security applications

The healthcare and biological technological breakthroughs of the last decade have begun to flesh out biomedical engineering and biotechnology as groundbreaking advents that are set to transform the future development of military operations. Biomedical engineering (largely underpinned by information and communication technology) is now revolutionizing clinical practice, breaking down space-, time- and cognitive-barriers in both civil and military fields. Moreover, the spectacular development of biotechnology has made it one of the keys to ensuring countries' security, while the current healthcare crisis has brought home the need of developing technology to combat biological risks.

In December the 19th UPM-FAS Days were held under the title "Biomedical engineering and biotechnology for defense and security applications" with the aim of analyzing the level of development of this technology in the Universidad Politécnica de Madrid (UPM) and in Spain's armed forces, as well as the collaboration possibilities between the university and the armed forces in R&D projects.

One of the participants was Ricardo Sáenz, GMV's Defense and Security programs manager. In the section dedicated to soldier augmentation technology he gave a paper setting out the company's soldier system activity and in particular one of the use cases of the CLAUDIA project being carried out by GMV in collaboration with the UPM for the European Defense Agency (EDA). CLAUDIA is working on a solution combining autonomous drones with artificial intelligence processes in edge computing. The drones act as dismounted soldier early-warning devices, boosting the soldiers' security and, thanks to edge computing, doing so without demanding a higher cognitive load.

GMV reinforces its defense and security business with the acquisition of Everis's GNC division

As well as taking on this division's staff GMV will also take over and continue all contracts underway at the moment of the takeover

GMV, an international defense and security benchmark, has acquired Everis's guidance, navigation and control (GNC) division (currently NTT DATA) to reinforce its own GNC capabilities and strengthen its position in the field of European defense cooperation.

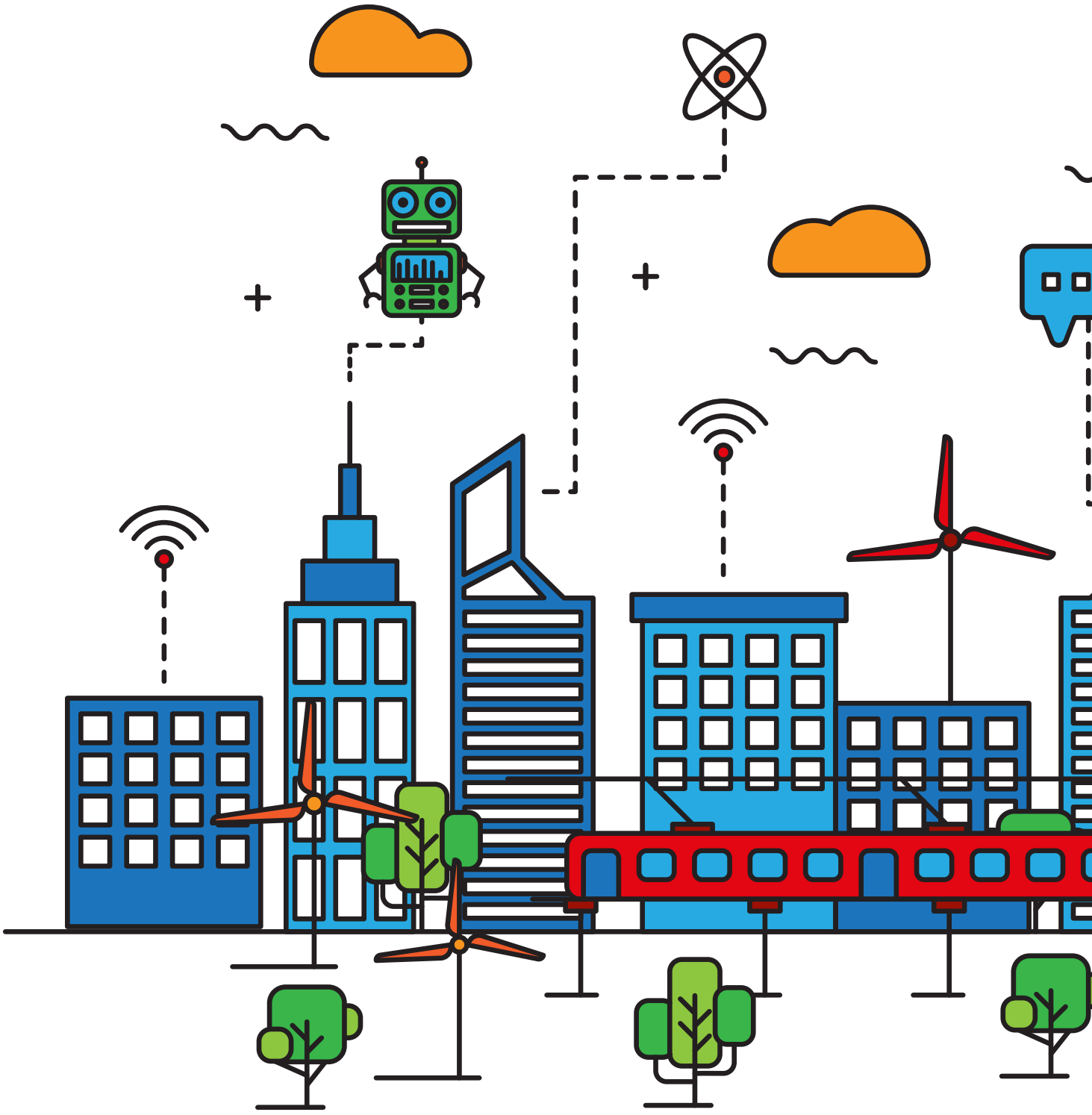
The clinching factor in deciding to go ahead with the takeover was the complementary and reinforcing fit of the Everis division's staff, technology and markets. Of high prestige in the defense sector, this division boasts a notable portfolio of clients, projects and technical-assistance services for both national and international organizations.

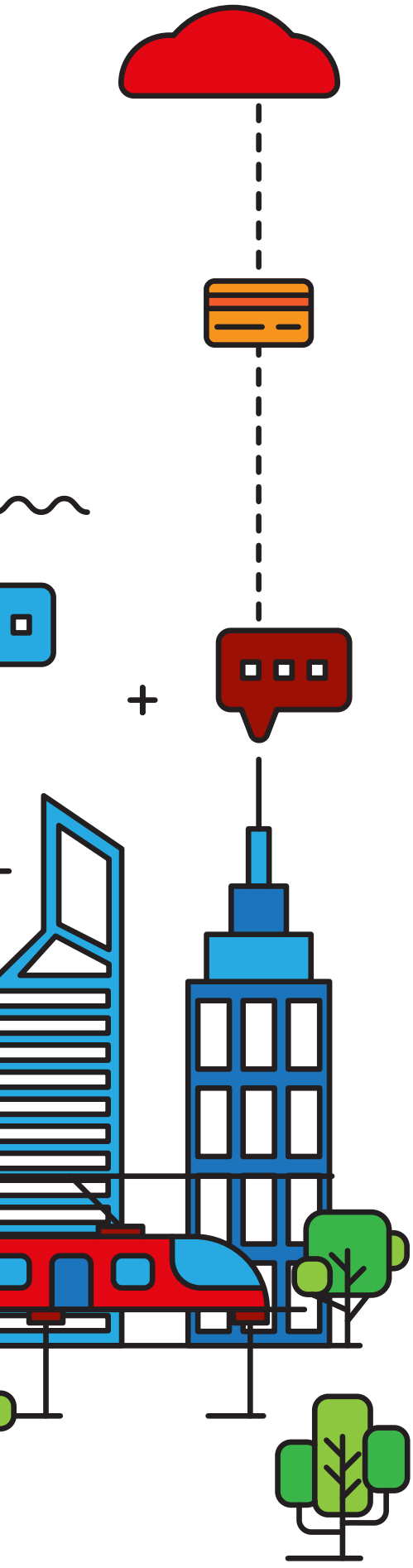
GMV is bringing into its own team the staff of Everis's GNV division, a group of highly skilled workers who share GMV's hallmark values and philosophy of excellence. GMV will also take over the division's current contracts at the moment of its acquisition, prime among them being its participation in the FIRES project and also its role as coordinator of the eCOLORSS project, both under the EDIDP umbrella.

Now boasting a staff of over 2500, GMV is a tried-and-tested supplier in engineering, design, integration, testing, verification and maintenance of defense and security systems. GMV's prime activities in this area are command and control systems, intelligence, surveillance and reconnaissance (ISR) systems, navigation, dismounted soldier systems, cyberdefense and simulation and training. The company also specializes in the development and marketing of new-generation unmanned aerial systems (UASs) for defense purposes.

At home GMV is a go-to supplier of the Spanish MoD and Ministry of the Interior. The company is a supplier of JISR and signal intelligence systems, C4I command and control systems for the Spanish army; it is also a leading firm in the development of avionics systems (A400M, ATLANTE, etc). It also forms part of the SATNUS consortium, acts as national leader of the NGWS/FCAS Remote Carriers Pillar and of the SMS initiative for development and promotion of Spanish solutions in the area of missile systems and other high-performance guided munitions.

On the world stage it is working, among others, for the FRONTEX Agency, the European Defense Agency, the European External Action Service, the European Maritime Safety Agency, NATO organizations and defense ministries of NATO countries on both sides of the Atlantic. GMV also features prominently in the European Commission's framework security research projects, mainly Horizon Europe and its forerunner H2020. It is also one of the European companies with the biggest participations in the European Defence Industrial Development Programme (EDIDP).





Smart and Cybersecure Cities

Digitalization opens cities up to diverse cyber risks, so new defense lines have to be set up to meet them

Major capital cities are now carrying out their digital transformation processes. Witness Madrid, where all municipal services, ranging from streetlight repair to refuse collection, are now integrated into the MiNT monitoring platform. In Barcelona too the public transport system has now been digitalized.

Digitalization represents a great chance to make our cities smarter; the downside is that it also gives cybercriminals new leeway for their operations. Mindful of this risk, cities have upped security requirements in any public tenders financed with recovery funds.

Any digitalization process should always be carried out with design-up security. From a technology point of view, after all, a smart city is made up and modeled by several components communicating with each other. These components are also underpinned by service-implementing hardware with several software layers, which analyze and store data or send it on to the various communication channels. The sheer complexity of these solutions and the advent of new smart-city use cases are opening us up to new cyber-risk scenarios, calling for the implementation of new lines of defense.

Take the following example. One of today's main cybersecurity concerns is to guarantee integrity of the many sensors rolled out in cities, which cannot be configured securely or tested conveniently.

Another of the smart city factors to be taken into account is its attack surface. This increases in line with infrastructure complexity and system rollout but it is also affected by existing component-service interdependence, by citizen connectivity and constant dataflow on the whole city-modeling platform. Any device connected to a smart city platform might therefore serve as entrance point to a large-scale attack.

It is hence proposed that any technological solution should incorporate such cybersecurity features as proper service-access authentication, automatic updating as far as possible, communication encryption and a monitoring system to flag up any security incidents, carry out security audits and respond more quickly to any security incident.

All these measures should place a special stress on preservation of data security, which have to be prioritized from the very start of any service-provision development, bringing security experts into the teams to identify any weak points, propose suitable data encryption measures, establish cybersecurity compliance thresholds and thus reduce infrastructure risk levels in the provision of essential city services.

GMV at Banksec, the finance cybersecurity conference

The European Association for Secure Transactions (EAST) has published a report showing that ATM fraud has plunged during the COVID-19 pandemic. Logical and ATM malware attacks, on the other hand, have soared by 44% and many of the reported attacks were of the black box type.

Attacks of this type, also known as jackpotting, consist of cash-out orders sent directly to the ATM by an unauthorized device. In recent years attacks of this type have managed to empty ATMs in Europe, Asia and the Americas, involving losses worth several million euros. This clearly shows the need for protecting ATM software. 2020 losses from logical and malware attacks rose by 14% from 1.09 to 1.24 million euros.

As well as jackpotting there are other threats banks need to consider, such as card cloning, false devices installed in ATMs, fraudulent apps, etc. For this reason the finance sector cannot afford to slacken the ongoing effort to raise its infrastructure security level, keeping a weather eye open for new threats that might jeopardize this sensitive infrastructure and react as soon as they appear on the scene.

To address this problem GMV duly made its yearly appearance at Banksec, the London conference put on by Retail Banking Research (RBR) at the end of the year, focusing on ATMs, payment methods and cybersecurity. GMV showcased its range of solutions for protecting the assets of the finance sector. Witness, in pride of place, GMV's inhouse and custom-built ATM protection product, ***Checker ATM Security®***, now installed in 250,000 ATMs in 40 countries around the world.

Industrial Cybersecurity: the New Profession

Much has been said about cybersecurity as the necessary or essential technology for the new 4.0 era. Increasing integration of the smart factory with the internet-based cloud now makes it vital to protect critical infrastructure from cybernetic attacks. But this issue is complex. We need professionals well genned up on all the following: an industrial plant's operational requirements, availability and functional security; the specific features of industrial communications; Ethernet architectures; the capacity of switches, routers and firewalls, as well as the norms defining target architecture for protecting infrastructure of this type.

All this was brought under the spotlight in the panel discussion "Industrial Cybersecurity: the New Profession", held in early December under the sponsorship of GMV and Siemens, and drawing on the expertise of professionals like Javier Hidalgo, industry solutions architect of GMV's Secure e-Solutions sector.

In the opinion of GMV's representative, what we now call the digital transformation is tantamount to the fourth industrial revolution. He added three industrial cybersecurity messages. First, security is security in any area whether at IT or plant level. Second, cybersecurity is not a technological problem but rather a problem of people, processes and knowledge». And last but certainly not least, we should design our cybersecurity approach on the premise that sooner or later we are bound to suffer an intrusion or incident.

Opinion

2022 Cybersecurity Trends

Which cybersecurity service and technology trends are likely to feature in 2022?

The new pandemic working environments have greatly accelerated the takeup of technology that had up to now been piecemeal in Spain.

The worldwide trend is towards geographic globalization of cybersecurity, differentiated only by the disparate development of telecommunications in each country.

In 2022 we will see more manufacturer purchases and mergers. The biggest cybersecurity manufacturers are therefore likely to enlarge their portfolio in order to provide an all-in, across-the-board service. At the other end of the scale many startups will continue to spring up, offering niche solutions capable of dealing with very specific problems.

From the security-services point of view, these will be geared towards specialist benefits over and above that which artificial intelligence (already embedded in technology) offers automatically. A cast-iron technical solvency will be needed to cater for a highly demanding and globalized environment.

Which will be the main cyberthreats faced by organizations?

As a result of this geographical globalization in first-world hi-tech societies, there will still be a scaling up of increasingly complex multi-vector attacks, which, though it might seem contradictory prima facie, will also be highly automated.

The organizations' main challenge now is to ensure they are working from a prevention viewpoint rather than merely detection and response.

They will have to protect themselves at all levels from corporate to distributed as a single integrated block. Time will be crucial.

Which new breakthroughs will GMV be presenting throughout the year to meet these cyberthreats and the needs of user organizations?

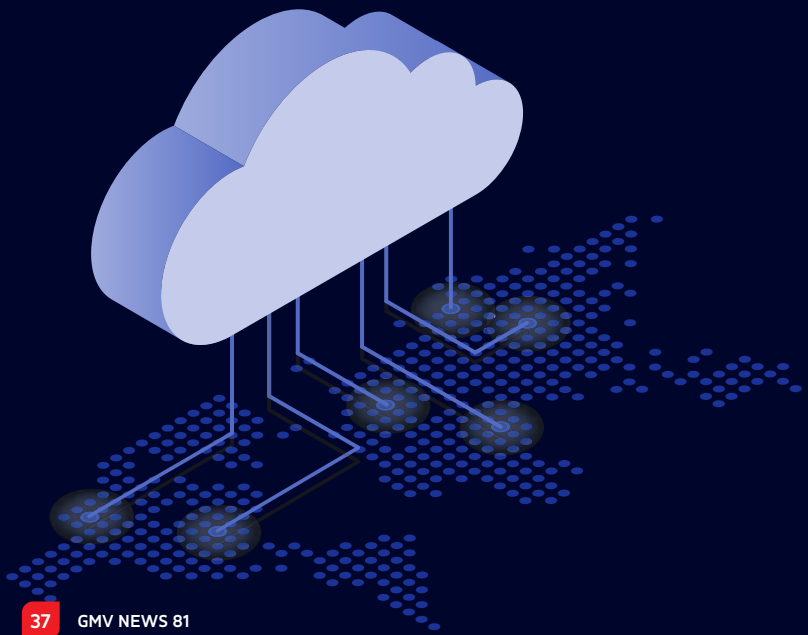
The new working models bring in new, inherent cybersecurity challenges. The DevOps boom and the new infrastructure based on containers and cloud environments, both public and private, mean it is vital to look for an approach that guarantees protection of these new hybrid environments in a uniform way.

The increasingly sophisticated threats, moreover, mean more attention now needs to be paid to prevention without thereby overlooking detection and response.

Additionally, the specific needs of each sector also have to be taken into account, adapting cybersecurity to suit in each case: it is not the same thing to protect, on the one hand, a crucial-infrastructure firm and, on the other, a legal or tourism firm. Speed of takeup also needs to be factored in here, as well as the integration and implementation of the new environments, respecting the particular pace in each case.

Nathalie Dahan
Head of Partner Strategy of GMV's Secure e-Solutions sector

"Now, more than ever, it is crucial for every public and private organization to work with a cybersecurity expert along the whole journey"



Design-up protection: how Ibero-America is going about it

GMV took part in the webinar "Design-up privacy", put on in mid-December by the Ibero-American Data Protection Network (*Red Iberoamericana de Protección de Datos*) and the Spanish International Development-Cooperation Agency (*Agencia Española de Cooperación Internacional para el Desarrollo*) with the collaboration of the Spanish Data Protection Agency (*Agencia Española de Protección de Datos*).

Antonio Gómez, business development manager of GMV's Secure e-Solutions sector, shared his knowledge and expertise in the debating panel "Design-up privacy: a vision from its implementation, commissioning and law abidance".

Antonio Gómez holds Big Data to be a cornerstone of the unprecedented digital transformation process we are currently living through; he likewise argues that protection of this data takes on special importance, not only as a legal obligation but also because any breach could severely dent any organization's business reputation.

Gómez spoke about GMV's inhouse ***uTile*** solution, developed by its AI team, as a prime example of the company's cutting-edge privacy business. ***uTile*** enables confidential and private data to be mined and harnessed for training up machine-learning algorithms and analytical models without jeopardizing data privacy and while complying at all times with any company's own data-privacy rules and current law.

Gómez focused on specific use cases of ***uTile*** in the government arena, such as finding out the results or impact of government policies. Examples might be ascertaining whether the minimum living wage is meeting its remit; measuring the impact of lower NI contributions (due to layoffs, etc) in future retirement payments without compromising data confidentiality and without needing to establish more precise budgets, working as it does from the data of various government authorities.

#hc0n 2022, hacking and cybersecurity conference

On 4 and 5 February GMV took part in #hc0n, the yearly hacking and cybersecurity conference put on by Hackplayers.

Óscar Alfonso Díaz, cybersecurity auditor of GMV's Secure e-Solutions sector, gave a paper under the title "Hacking RF for dummies", introducing us to the world of radiofrequency hacking for those with no previous experience. Óscar ran through the basic concepts, pointing out the necessary hacking hardware and attack types and perils.

eBook "Cybersecurity in the tourism sector"

The *eBook* "Cybersecurity in the Tourism Sector", drawn up by the Group of Tourism Technology Centers (*Grupo de Centros Tecnológicos de Turismo*) with the institutional support of Spain's National Cybersecurity Institute (INCIBE in Spanish initials) was presented under the aegis of FITURTECHY2022, the technology slot of the International Tourism Tradefair FITUR.

GMV's cybersecurity and tourism expertise helped to draw up this *eBook*, which will in turn help to create a secure and trustworthy tourism. In the opinion of Joan Antoni Malonda, Tourism Business Developer of GMV's Secure e-Solutions sector:

"The tourism sector deals with a huge amount of sensitive information, whereas only 5% of companies are considered to be cybersecurity experts. This makes it a juicy target for cybercriminals".

Tourism firms are exposed to many risks (ransomware, phishing, etc), which have even been racked up since the rapid digitalization unleashed by the pandemic. Teleworking stations, after all, tend to be much less secure and controlled than in-company workstations. Malonda therefore argues that cybersecurity should be considered a cornerstone of any strategic company plan, covering at least two fundamental aspects.

Firstly, mitigating cybersecurity risks (identifying, protecting, detecting, responding and recovering - NIST Cybersecurity Framework) by setting up a cybersecurity masterplan that flags up any threats by conducting compliance audits and analyzing applications and infrastructure (including Wi-Fi setups). Technological cybersecurity solutions will also be set up, working with a BIA and business continuity plan. Secondly, cybersecurity training also needs to be stepped up and its importance brought home to one and all, doing so by analyzing the likelihood of success and carrying out simulations of phishing attacks, interactive training modules, incident reporting tools and result reports.

AI-guided acquisition of diagnostic ultrasound images

A GMV-led consortium is to create a federated network to speed up AI takeup in healthcare systems

The GMV-led TARTAGLIA project aims to set up a federated network to speed up AI takeup in healthcare and health-research systems. Under TARTAGLIA GMV is responsible for a specific research package that aims to democratize the takeup of ultrasound imaging for diagnostic purposes. This is a very safe, non-invasive technique with no adverse effects for patients; moreover, its cost is low as compared with other imaging diagnosis techniques and it is capable of observing a high number of organs in real time.

The drawback is that it is more complex than any other imaging diagnostic technique, so, at the present time, the necessary images can be acquired only by clinicians with sufficient expertise. GMV's artificial intelligence and software developments engineers are working on systems that enable persons of no previous expertise in the technique to obtain quality diagnosis images without expert help. GPs and community doctors working in primary healthcare centers and clinics or even thousands of doctors working in far-flung rural areas can then use the technology to carry out an initial screening of these images without resorting to expert echographers. Healthy patients are no longer needlessly sent to hospitals and this saves unnecessary downtime.

Carlos Illana, leader of the aforementioned work package and product head of GMV's Secure e-Solutions sector explains it as follows: a compact ultrasound device enables a great number of body organs to be examined efficiently and in automated form. This means not only that the disease evolution can be closely monitored but also facilitates early detection of many diseases whose prognosis is much better if treated in early stages of development".

One of the specific cases where early detection is crucial is heart failure, reckoned to be the main cause of death in Spain ([1]); in many cases this death is avoidable. In recent decades, indeed, the rate of heart failure is increasing in developed countries ([2]). In Spain in particular this rate is even higher than in other European countries and the United States. In our European neighbors and the United States the heart failure rate is 2%, while in Spain it has crept up to 5%

(with a top-heavy age breakdown, soaring from 2.7% in Spain's over 45s to 8.8% in its over 74s). According to Spain's National Statistics Institute, heart failure accounts for 3% of total male deaths and 10% of female deaths each year in Spain.

The heart is a muscle in continuous movement. It is therefore no easy task to assess cardiac function with any medical imaging technique that captures its anatomy at one instant of time (such as magnetic resonance imaging or computerized axial tomography). Whenever any anomalies come to light in the electrocardiogram, the cardiologist resorts to ultrasound imaging to display dynamic heart behavior and make the most effective diagnosis. Until the patient's specialist appointment comes around, the disease will not be detected.

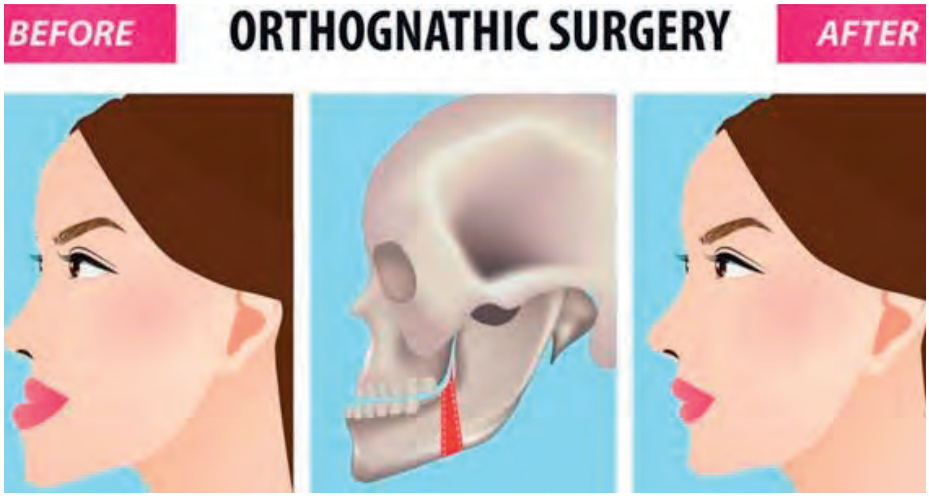
If technology allowed primary healthcare physicians to capture the ultrasound images themselves and interpret them accordingly, this would win a lot of time in serious cases and free cardiologists of trivial cases. Enter TARTAGLIA, whose technology is likely to bring this about in the near future.

TARTAGLIA has received funding from the Spanish Ministry of Economic Affairs and Digital Transformation as part of its Transformation, Resilience and Recovery Plan funds..

(1) *Soriano, J. B., Rojas-Rueda, D., Alonso, J., & Antó, J. M. (2018). La Carga de Enfermedad en España: Resultados del Estudio de la Carga Global de las Enfermedades 2016: Medicina Clínica. La carga de enfermedad en España: resultados del Estudio de la Carga Global de las Enfermedades 2016 | Medicina Clínica. Retrieved from https://www.elsevier.es/es-revista-medicina-clinica-2-avance-la-carga-enfermedad-espana-resultados-S0025775318303312*

(2) *McMurray, J. J., & Stewart, S. (2000). Epidemiology, Aetiology, and prognosis of heart failure. Heart (British Cardiac Society). Retrieved from https://pubmed.ncbi.nlm.nih.gov/1076891*

GMV brings artificial intelligence to jaw surgery



GMV has been chosen as technology partner of the project led by the prestigious Lithuanian surgeon Simonas Grybauskas, a worldwide leading light in maxillofacial surgery. Jaw surgery, also known as orthognathic surgery, corrects irregularities of the jaw bones and realigns the jaws and teeth to improve their function. GMV has developed AI-based technology capable of automating part of the jaw-surgery planning procedure, slashing the time needed for these operations and improving their predictability. The service is cloud-hosted so the planning can be accessed from anywhere and from any device, and the information can then be shared between the various clinicians involved in the treatment.

GMV boasts a wealth of experience in developing technology for surgery of this type. Witness the work carried out under the NAVIPHY project together with the Mouth and Jaw Surgery Service (*Servicio de Cirugía Oral y Maxilofacial*) of the *Hospital Universitario La Paz* led by José Luis Cebrián. This work has offered surgeons "a simulation of the viscoelastic behavior of soft tissue, allowing us to predict the patient's post-operation look during virtual surgery planning and, later on, its functional behavior", explains Carlos Illana, product head of GMV's Secure e-Solutions sector.

Virtual surgery planning (VSP) in orthognathic surgery involves a definition of the cuts to be made on the jaw and subsequent realignments to define the final position. It represents a great advance for both surgeons and the patients themselves. It allows the surgeons to plan the surgery exactly, helping them to guarantee that the surgical plan will coincide with the patient's anatomy; it also cuts down reconstruction time. As for the patients, apart from the physiological benefits, they can also be shown beforehand what the final result will be like; this is crucial in view of the psychological impact any change in the face might have. And, indeed, the clinical results using this technology are uncannily accurate.

Illana explains that "the AI-algorithm developments under this project represent a paradigm switch, enabling any clinically-accredited maxillofacial surgeons to feed all patient information into the platform and receive it in automated fashion, following the scheduled surgery plan". Around the world there are over 28,000 jaw surgeons carrying out operations of this type. All of them "will now be able to benefit from this highly-accurate technology, while the other clinicians involved in this process (orthodontists, biomedical engineers, etc) can work together in the cloud, speeding up surgery times and cutting down the risks associated with the sharing of information with other methods".

Radiance, top-accuracy planning

Medical Physics, the scientific journal of the American Association of Physicists in Medicine, publishes original research with a high impact on physics, scientific imaging and engineering to improve therapy and diagnosis. It has recently published an article called "XIORT-MC: A real-time MC-based dose computation tool for low- energy X-rays intraoperative radiation therapy", written by Carlos Illana, product head of GMV's Secure e-Solutions sector and the *Universidad Complutense de Madrid* researchers Paula Ibáñez, Amaia Villa-Abaunza, María Vidal, Pedro Guerra, Sergio Graullera and José Manuel Udías.

This research article concludes that the XIORT-MC algorithm built into ***Radiance***, GMV's inhouse intraoperative radiotherapy (IORT) planner, can compute highly accurate dose distributions within seconds, whereas other available algorithms would take hours. The speed and accuracy of GMV's software means it can be used in the operating theater during IORT treatment. This directly boosts the control of high-radiation doses to be administered in the pertinent area, making sure of proper coverage without jeopardizing high-risk organs. The administered dose is therefore guaranteed to be the minimum possible within tolerable ranges. The net result is much safer treatment.

DALEM, space-to-healthcare technology transfer

The spinoff application of GMV-developed space-navigation-algorithm technology to the monitoring of pigmented skin lesions and the early detection of melanomas

The Biomedical Research Foundation (*Fundación de Investigación Biomédica*) of the *Hospital Universitario La Paz de Madrid* (FIBHULP) is collaborating with the technology multinational GMV under the DALEM research project, applying spinoff space technology to healthcare, to achieve early phone-app detection of pigmented skin lesions. The idea is to enable people to examine their own skin and thus reduce mortality from skin melanomas.

In this healthcare project GMV will be applying its inhouse, vision-based, space navigation algorithms for accurate descent and landing of space rovers. Today's smartphone cameras have sufficient quality and resolution for GMV's technology to draw up an image-based skin map, helping patients to examine their own skin.

Ander Paulo Mayor Ibarguren, Marta Feito Rodríguez, Fátima Albizuri Prado and Rosa Feltes Ochoa, specialists in surgical dermatology and venereology of the *Hospital Universitario La Paz* are all participating in this project. Feltes speaks for them all when she says that "This technology potentially represents a huge advance on existing lesion-imaging systems. None of the currently available applications provides a means of detecting new moles or changes in existing moles over time. There is therefore a pressing need for a sure and automated way of ascertaining whether or not there have been skin changes before the next monitoring appointment. Furthermore, the recording of images at different moments, and with an acceptable level of robustness, could come in very useful for the necessary pre-diagnosis monitoring of pathologies like melanoma".

In the words of Carlos Illana, product head of GMV's Secure e-Solutions sector: "The emergency radiology service of the *Hospital Universitario La Paz de Madrid* is a past master in image-based guided explorations; this will help our software and artificial intelligence team to achieve significant clinical results. This new form of patient-dermatologist interaction will improve the monitoring procedures, currently possible only by way of expert consultation but soon to become a part of the patients' daily routine".

GMV to supply the new passenger-information and video-surveillance system for Barcelona's urban buses

The public-tender contract awarded to GMV is threefold: supply of onboard security enhancement systems, the passenger information system and a fleet-wide video-surveillance system

GMV will provide Barcelona Metropolitan Transport (*Transportes Metropolitanos de Barcelona*: TMB) with a new passenger information system for its 1170-bus fleet. The 10-million euro contract awarded to GMV under public tender embraces differentiated lots, GMV coming out the winner in all three.

Lot 1 includes supply of the buses onboard system architecture serving lots 2 and 3. GMV will supply the 1170 buses onboard, multipurpose CPU for running the passenger information of lot 2 and the video-surveillance systems of lot 3. It will also include necessary network architecture and a new power-management system for switching onboard equipment on and off.

Lot 2 takes in the passenger information system. Here, GMV will supply 1119 buses with 29" and 21" panoramic screens including a built-in CPU to give accurate, real time passenger information. The supply will also comprise diverse additional hardware such as amplifiers, ambient microphones and audible information for the visually impaired, activated by a handheld as they approach the stop.

Functionally the new passenger information system will provide a very flexible visual interface allowing TMB to configure the passenger information shown on the panoramic screens supplied with the system, tied into audiovisual content through diverse configurable service items (line, destination, ETAs, links, etc). The new system will also enable a hearing-based passenger-information channel.

Lot 3, lastly, caters for the video-surveillance system. Apart from the necessary lot-1 software, it includes 4590 onboard cameras, 147 outside cameras and 42 license-plate-recording, bus-lane monitoring cameras. Functionally, the onboard system will record all camera images plus service alarms and events. It will also have several advanced smart-video-analysis tag-ons for future ridership counting services, lost-object searches, fallen-passenger alerts and for constructing origin/destination matrices.

This new award further strengthens GMV Barcelona business as a go-to supplier of one of the cutting-edge ITS transport operators, providing on this occasion state-of-the-art passenger information services and improving onboard security.

GMV supplies Lisbon tramline's onboard systems

■ CAF (Construcciones y Auxiliar de Ferrocarriles),), leader in the design and execution of integral mobility systems, has selected GMV to supply the onboard ITS systems of the 15 URBOS 3 streetcars to operate in the Portuguese city of Lisbon. The ITSs included in this supply are the passenger information system, the PA and intercom system. This project also includes supply of the onboard-communication Ethernet.

Passenger information is to be shown not only on front- and side-LED type panels, connected up with the system controller, but also on TFT panels of diverse formats, taking in indoor 21.5" TFT monitors with a classic 16:9 display format, plus groundbreaking stretch-type 28" screens, showing between them service information in the best possible way. The system is topped up with a 32" vertical-format model, mainly for showing publicity content. The control component will generate both service information plus programmed publicity content, enhancing the passengers' overall visual experience.

The tram-long PA system is mainly digital, incorporating too an analog backup to boost system reliability. The intercom system comprises 6 IP intercoms situated close to the doors to ensure rapid emergency response to any passenger incident.

All these systems will be integrated with the tram's control and monitoring system to receive necessary control information and reporting states and alarms.

The project is now up and running and the first unit is due to be brought into service next year.

GMV to enlarge Palma de Mallorca's EMT's ticketing system

■ GMV is to enlarge and enhance *Empresa Municipal de Transportes de Palma de Mallorca's* ticketing system, to enable passengers to charge up their citizen cards without needing to go to any physical recharge point.

Palma EMT had already been fitted with GMV's ticketing system as part of the supply carried out for the whole Mallorca Transport Consortium (*Consorcio de Transportes de Mallorca*), with the citizen farecard being recharged at several points around the city of Palma de Mallorca. The COVID pandemic, however, and the concomitant need to reduce cash payments, made it advisable to set up a remote internet recharge system.

In this setting, EMT de Palma has recently turned to GMV anew for software developments to set up a citizen farecard-recharging web service. A section of EMT de Palma's website will allow passengers to recharge their farecards by using the web service to be set up by GMV for this purpose.

In specific terms, the software of EMT de Palma's current ticking system will be suitably tweaked and adapted both in onboard equipment and the control center. At onboard equipment level GMV will update the driver's console software and passenger validators to incorporate recharge white lists. The control center, for its part, will generate and publish web services available by fare/passenger type and consolidate them within the system.

GMV wins a new contract for the provision of tram positions in Warsaw

The Warsaw tramline has signed with GMV the vehicle-locating service contract, which calculates deviations and displays installed equipment data

The largest collective transport system in Poland operates in the capital city of Warsaw. The system also comprises the country's largest tram fleet, currently numbering around 530 vehicles belonging to the city operator, Warsaw Trams (Tramwaje Warszawskie). GMV, continuously since 2011, has been providing the carrier with IT solutions and Dynamic Passenger Information services.

The first project started in March 2011 and included the delivery of onboard geolocators for the entire tram fleet, 41 new PIS panels at the stops, the implementation of a new central Dynamic Passenger Information System (GMV's ***SAE-R*** railway-fleet management software) as well as the inclusion of the existing 27 Gorba's PIS panels at tram stops.

In subsequent years the system underwent extensions and major modifications. Among other things, the central software (***SAE-R***) was migrated by GMV to the carrier's cloud service and open communication interfaces (APIs) developed by Warsaw Trams.

The latest investment by Warsaw Trams is a project to replace all onboard geolocators with new ones. Upon the award of a public contract, Warsaw Trams concluded with GMV the Contract for performance of the vehicle positioning service, calculating deviation as well as providing for data-display and -exchange in the delivered and installed equipment. GMV will equip 650 trams with sets of onboard equipment (the latest EP200), adding up to a total of 731 onboard sets taking into consideration bi-directional trams.

The new onboard computers will ensure the precise, GNSS-based positioning of the tram, calculation of deviation (late or early running) as well as wireless communication with the central systems of Warsaw Trams. On the 7-inch displays the driver will see the calculated deviation (which will make it possible for the tram driver himself/herself to control punctuality) and issue any messages, warnings, and recommendations from the Traffic Control Centre.

Real-time data on the location of each tram is fed into the Dynamic Passenger Information System, where the GMV's SAE-R software estimates the vehicle's times of arrival (ETA), which is then displayed on the tramstop panels and on the PIS website (https://tw.waw.pl/sip/). The position data is also used in the system for giving ride priority to trams at junctions (the so-called green wave).

GMV wins multi-year FMS and PIS maintenance contracts in Gdańsk and Gdynia

Implementation of Gdańsk and Gdynia´s integrated traffic management system, was completed in 2015. GMV provided the Fleet Management and Passenger Information System (SAE software, onboard computers, among others) for the transport organizers to both cities.

After the end of the 2019-to-2021 warranty period, , the system was covered by the maintenance contracts between GMV and the Public Transport Authority in Gdańsk (ZTM) as well as between GMV and the Public Transport Authority in Gdynia (ZKM).

The award of recent public contracts enabled GMV to conclude in January 2022 another multi-year contract with ZKM for post-warranty maintenance of the FMS and PIS in Gdynia. Under the concluded contract GMV is responsible for maintenance of the SAE central software plus the auxiliary applications as well as the sets of onboard equipment in 340 public transport vehicles. Each onboard set includes the M20 onboard industrial computer, driver's TFT touch screen console, and TLP (Traffic Light Priority) radio. Under the contract, the Purchaser may also use a package of development hours for developing new system functions.

Together with the twin system operating in Gdańsk, which has also been covered by GMV maintenance since January 2022 (the Purchaser is ZTM in Gdańsk), the company is responsible for the efficient operation of the city´s integrated SAE systems, as well as 825 sets of onboard equipment in public transport vehicles (buses, trolleybuses, trams) and 45 displays at the stops.

The collective transport comprises Poland's second largest public transport vehicle fleet-management system. GMV will be responsible for maintaining the integrated TRISTAR system in Gdańsk and Gdynia until the end of 2024.

GMV contract wins follow on from Poland's maintenance contracts

The largest and most complex system implemented in Poland by GMV is the Central Public Transport Management System in Szczecin with more than 400 vehicles and 93 on-stop displays. The warranty period expired in 2018.

At the end of 2021, GMV concluded its fourth consecutive post-warranty system servicing contract. Under this contract, in 2022, GMV is maintaining the Fleet Management and Passenger Information System, the complete electronic ticketing system with the central software, 36 stationary and 317 mobile ticket vending machines as well as 1,679 onboard NFC validators. In addition, other subsystems, such as the onboard CCTV video surveillance system or the automatic passenger counting system, are also covered by GMV's maintenance.

Bydgoszcz is a city where GMV's Public Transport Fleet Management and Dynamic Passenger Information systems have been operating since 2012. Under newly concluded contracts, in 2022, GMV is providing the Municipal Roads and Public Transport Authority with the services related to the upkeep and maintenance of the server infrastructure together with the SAE central software, 125 LCD panels at the stops, and GPS vehicle modules in 325 public transport buses and trams.

In Toruń GMV is carrying out post-warranty upkeep and maintenance of the tram system launched in 2014. In 2022 the service is being provided on the basis of another maintenance contract, covering comprehensive servicing of all elements of the Central Fleet Management and Dynamic Passenger Information System, including the SAE central software, vehicle modules in 51 trams, and 67 LED panels at the stops.

In autumn 2021, GMV completed the implementation of a new Passenger Information and Fleet Management System for 150 city buses, which is now covered by GMV's warranty service.

Moviloc®, leading airport-vehicle supplier

MASA, Spain's top airport multi-service firm, has taken up ***Moviloc***® as its vehicle-fleet's telematic management supplier, not only of the parent company but also the joint ventures providing airport services for the airports of *Madrid-Barajas, Josep Tarradellas Barcelona-El Prat, Palma de Mallorca and Malaga-Costa del Sol*, Spain's four biggest airports (in this order) in terms of passenger numbers.

Moviloc® was chosen after thoroughgoing pilot tests to check out compliance with MASA's particular onboard-equipment and control-center requirements, the former including a locating device, driver identification with acoustic alarm and dead man's handle, and the latter taking in a runway satellite view with sufficient precision for creation of vehicle-working and -stop zones and a complete API Web Service for exchanging data with other applications.

This onboard configuration will ensure MASA's vehicles can be driven only by authorized personnel while also providing detailed traceability of those who are using them at any particular time, which work is being carried out and when. This traceability will help MASA prove its service performance and punctuality to its demanding final client, Spain's airport authority AENA.

Some of the many services to be carried out are vital for correct working of critical airport infrastructure, such as aircraft start-up aid, security controls and checks, aeronautic maintenance, outside aircraft conditioning, inter-terminal cargo transport, crew transfers and movement of persons with reduced mobility.

As of today the total equipped fleet adds up to 220 vehicles.

GMV is awarded several ITS maintenance contracts in Spain

In early 2022 GMV renewed significant maintenance contracts with major clients of the transport sector such as: ATM (*Autoridad del transporte Metropolitano*) with 629 vehicles shared out between 28 fleets, GM (*Guaguas Municipales*) with 256 single-fleet vehicles, and Avanza-CRTM (*Consorcio de Transportes de Madrid*) with 522 vehicles distributed in 5 fleets.

The ATM and GM fleets are running with GMV's inhouse fleet-management system while Avanza-CRTM's fleets have an all-in solution based on the fleet-management service plus GMV's ticketing and eco-driving tag-ons.

GMV carried out integral maintenance of all these systems at the three maintenance levels: level 1 (in situ equipment changes), level 2 (client-site board replacement) and level 3 (equipment repair in GMV's repair department). For any critical hardware and software incidents these clients are also provided under the contract with a 24x7 on-call service.

For each one of the contracts GMV has set up a project head in charge of the fleet's corrective/preventive maintenance from an internal maintenance web service and monitoring of the work up to full solution and closure, ensuring compliance with the contracted service level agreement (SLA).

GMV joins SERNAUTO

In February, GMV became a collaborating partner of Sernauto, Spain's Automotive Suppliers' Association. Founded in 1967 it incorporates about 85% of Spain's companies in this sector. Its prime function is to raise its members' profile vis-à-vis government authorities and public and private institutions at both national and international level.

Sernauto is also the go-to interlocutor for debating and defining industrial policy strategies and acts as a meeting point and liaison contact with all types of associated companies (major national and international groups, mid-cap companies and SMEs).

GMV's membership of Spain's biggest suppliers' association will enable it to work on technical committees, get to know the market better, including both suppliers and other manufacturers and spearhead sector trends. In the past GMV has collaborated with Sernauto on various forums, webinars and seminars and this ongoing collaboration will now be even more upbeat and fruitful.

GMV began working on automotive solutions back in 2004, developing technology for connected and autonomous vehicles (telematic services, GNSS-based positioning services, onboard cybersecurity and connectivity solutions, etc.). It has now become a leading light for manufacturers of worldwide status (OEMs) and TIER 1 suppliers of international components.

GMV joins the Spanish Smart Roads Forum

In February 2022 GMV joined the Spanish Highway Association initiative known as the "Spanish Smart Roads Forum", a platform that defines and optimizes the highways necessary for the sustainable mobility of the future.

This initiative, with over 60 participating public and private entities, aims to create a working and discussion space for information and communication technologies, au-tonomous driving, connected vehicles, artificial intelligence, Big Data and the Internet of Things (IoT) as part of the new developments and applications that are a reality today, or will be in the short term, on our public roads.

The focus is on these technologies, which will make it possible to improve traffic management and control, safety, convenience and travel efficiency, as well as re-ducing fuel consumption, reducing emissions and more.

The Spanish Highway Association (AEC) is an organization that has worked from the beginning to defend and promote highways. Their aim is to achieve safer, higher-quality roadways. In today's context, the AEC has initiated a smart roads forum that will bring together key mobility players.

By joining the Spanish Smart Roads Forum, GMV strengthens its commitment to the development of technology for achieving safer, more efficient and more environmentally-friendly mobility, offering its vision to the industry.

GMV wins the Galileo Green Lanes extension contract

The European Commission chooses GMV for developing a long-term technological solution to monitor green lane operation even after the pandemic

The European Union Agency for the Space Programme (EUSPA) has awarded GMV the contract to upgrade and develop the Galileo Green Lanes Project. The "Green Lane" border crossings, in which the crossing times, including any checks, should not exceed 15 minutes on internal land borders, were set up by the European Commission (EC) to guarantee the free flow of essential goods and services during the COVID-19 pandemic.

After an initial testing stage, when the concept was demonstrated and the collection of crossing times between member states begun, the EC selected GMV to develop a stable platform for its long-term operation. This will ensure correct operation of the "Green Lanes" in a persistent pandemic or post-pandemic scenario.

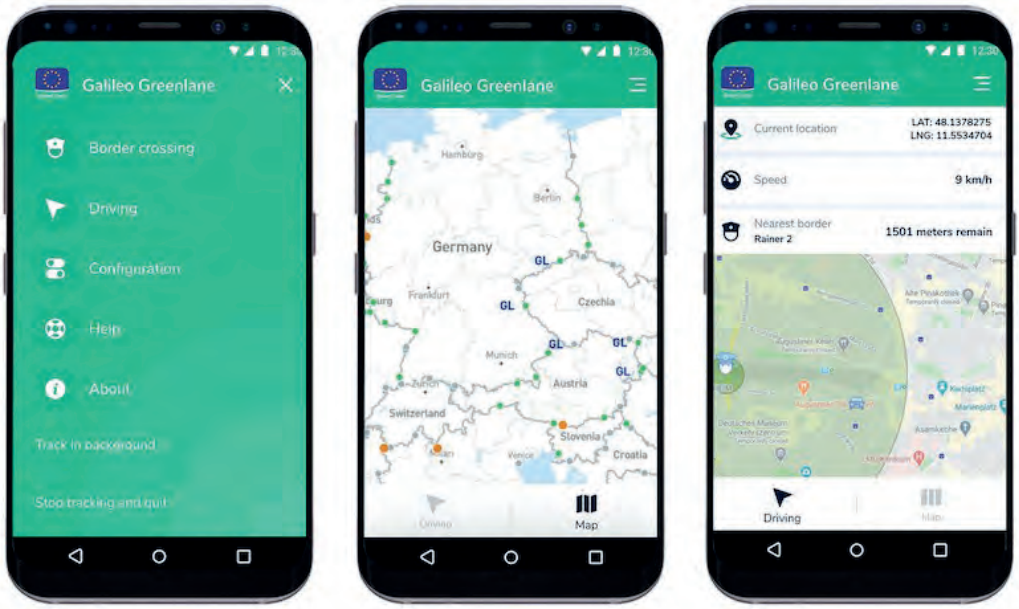
GMV's platform will integrate information from several data sources, including the main European traffic aggregators, public entities, fleet management operators and even the smartphones of the drivers themselves when they are driving in the vicinity of a border crossing, so that the system can analyze the available data and provide a reliable snapshot of the waiting times in the border crossings.

The modular design of the platform will also allow for future upgrades, adding further data sources and modelling additional types of points of interest for the transport community, such as service stations, resting areas, logistic infrastructures, or maritime ports.

The information will be available to drivers and transport operators through smartphone applications, both on the iOS and Android Operative Systems, so that they can take the information into account when planning their itineraries.

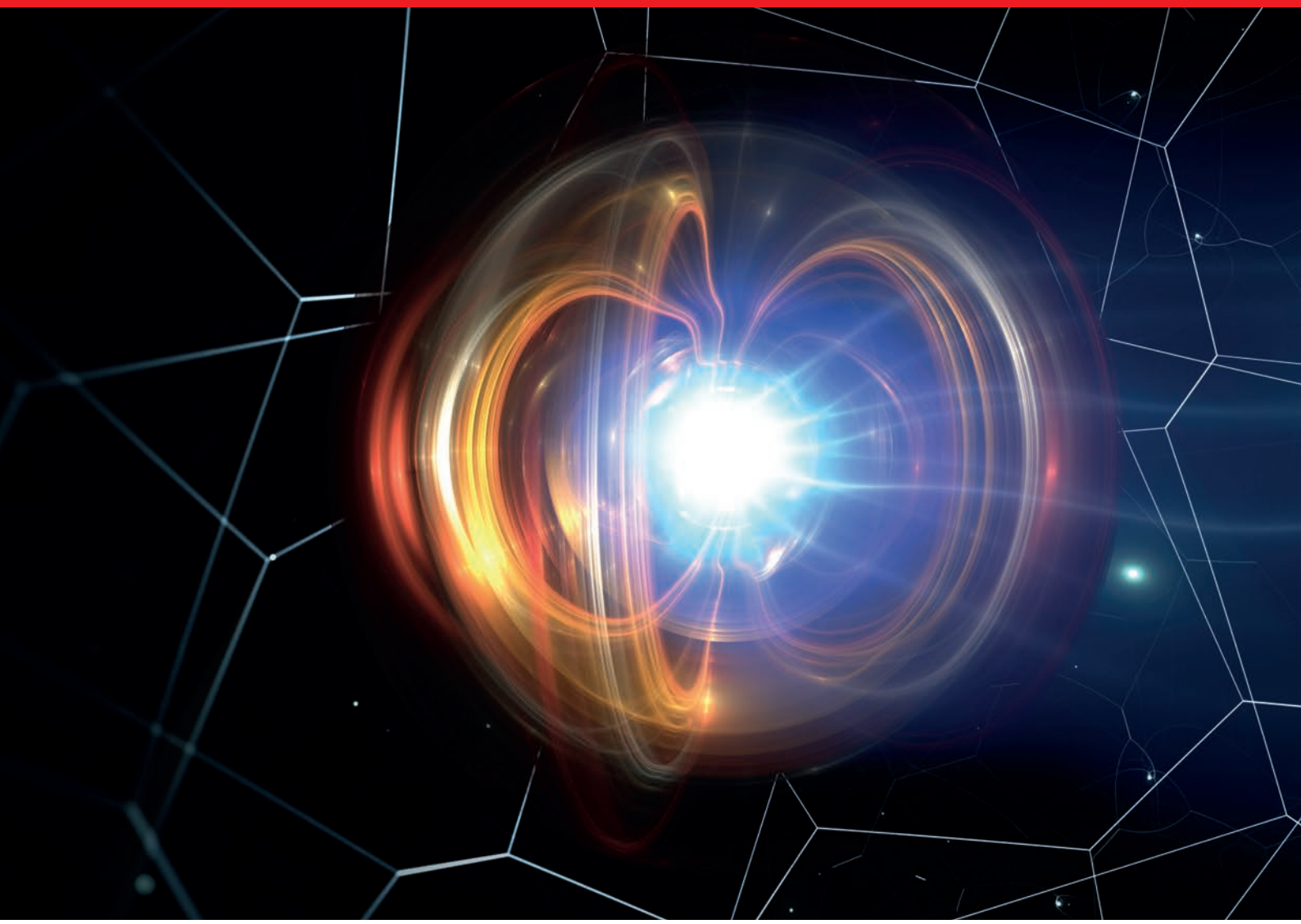
A third-party integration API (Application Programming Interface) will also be offered, so that the system information can be directly leveraged by transport operators in their fleet management systems or by external applications.

Finally, the gathered data will allow the EC to generate reports and analyze the delays in the different border crossings between member states and surrounding countries, in order to to guarantee compliance with European Commission Communication C(2020) 1897 final on the implementation of the Green Lanes under the Guidelines for border management measures to protect health and ensure the availability of goods and essential services.



European Global Navigation Satellite Systems Agency

Green Lane

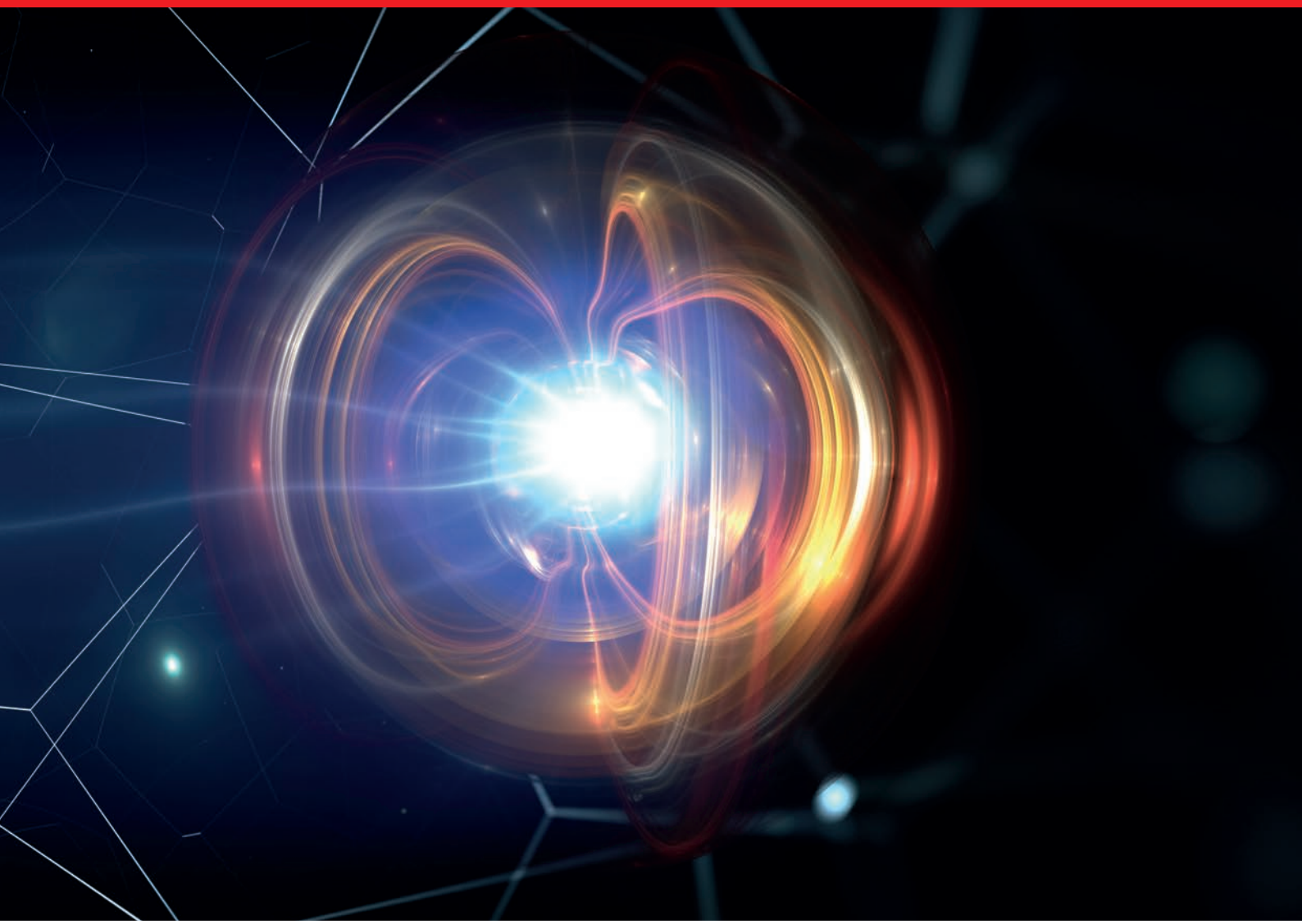


Quantum computing and its application to strategically important industries

CUCO kicks off, a project that sets out to solve problems that classical computation cannot solve in an efficient way

A 7-company consortium (Amatech, BBVA, DAS Photonics, GMV, Multiverse computing, Qilimanjaro Quantum Tech and Repsol), supported by five research centers (BSC, CSIC, DIPC, ICFO and Tecnalia), plus a public university (Universitat Politècnica de València) kicks off the CUCO project for research into quantum computing as applied to strategically important industries of Spain's economy: energy, finance, space, defense and logistics.

The CUCO project, subsidized by the Industrial Technology Development Center (CDTI in Spanish initials) with the support of the Spanish Ministry of Science and Innovation under Spain's Resilience, Transformation and Recovery Plan, comes into being as the first major quantum computation project at national and business level. Its remit is to promote scientific and



technological knowledge of quantum computation algorithms on the strength of public-private collaboration between companies, research centers and universities, in order to accelerate the mid-term takeup of this technology. A series of significant use cases in Spain's economy will be identified where proofs of concept may be carried out to ascertain whether quantum computation might improve on classic computation when striving to come up with answers to business needs and proposing the corresponding metrics. The use cases looked into will be earth-observation, the fight against climate change and environmental issues, supply-chain information traceability, optimization and simulation of complex financial calculations, signal intelligence, etc.

Quantum technology, and specifically quantum computation's huge calculation capacity is set to have a groundbreaking impact in many areas, potentially marking a new technological era. Spain cannot afford to lag behind here; it must be capable of leading this new race.

New R&D actions and sustainability

One of this project's aims is to win the consortium's companies pole position in quantum computing within their own sectors, preparing them for participation in international initiatives such as Quantum Flagship, Horizon Europe, Digital Europe and the European Defence Fund.

CUCO's quantum-computing research and its promotion of more ecofriendly algorithms is bound to have a positive knock-on effect on environmental sustainability.

> "The use cases looked into will be earth-observation, the fight against climate change and the environment, supply-chain information traceability, optimization and simulation of complex financial calculations or signal intelligence."

Financiado por la Unión Europea NextGenerationEU
Plan de Recuperación, Transformación y Resiliencia
Ministerio de Ciencia e Innovación
CDTI

#TourismDataSpace, a great chance for Spain's tourism

According to the figures of the "European Data Market Study", Spain's data economy in 2019 was worth 29.7 million euros, representing 2.5% of Spain's GDP. By 2025 this value is expected to climb to 54.4 million euros, representing 4.1% of the GDP, as long as the necessary legal, political and financing arrangement is set in place.

Along these lines the Spanish Secretary of State of Digitalization and Artificial intelligence set up in the SEGITTUR space of the FITUR tradefair (19-23 January) the first Spanish hub of Gaia-X in pursuit of the #TourismDataSpace. This workshop analyzed and discussed the various data-governance challenges and opportunities, use cases for the tourism sector as well as data sharing architectures and enabling technologies.

To complement this workshop, Spain's Technological Hospitality Institute (*Instituto Tecnológico Hotelero*: ITH) hosted the debate "Gaia-X: tourism data space and AI" in which Joan Antoni Malonda, Tourism Business Developer of GMV's Secure e-Solutions sector, took part together with Alberto Palomo, for the Spanish Data office, Mario Villar, from Valencia's Regional Government, Antonio López de Ávila, from Tourism Data Driven Solutions and ITI's Daniel Sáez.

The speakers talked about the various business opportunities spawned by this Tourism Data Space and the importance of companies all taking part and benefiting from it, as well as the clear boost to competitiveness for companies and tourism destinations on the strength of public-private collaboration.

From the more technological viewpoint, Malonda set forth the cybersecurity and privacy challenges thrown up by federated data architectures, calling as they do for enabling privacy solutions such as Privacy-Enhancing Technologies (PETs). Enter ***uTile***, GMV's inhouse solution for performing secure and private calculations on distributed data without thereby exposing it or moving it from its original site. ***uTile*** harnesses confidential data in order to improve machine-learning algorithms and analytical models, complying at all times with organizational remits, data-privacy obligations and current law.

10th Smart Energy Reference Guide on energy-efficiency-improving technology

The Smart Energy Reference Guide is the marquee document of digitalization solutions and technologies and of use cases and experiences, laying out the path for overcoming the main challenges and achieving the targets of competitiveness, resilience, innovation and sustainability in the interests of greater welfare for all in the future.

For yet another year GMV has collaborated in the latest version of this essential guide for any organization committed to sustainability, the Agenda 2030 goals and Europe's green recovery plans.

Miguel Hormigo, Industry Director of GMV's Secure e-Solutions sector, gave his take in the section of the guide dedicated to enerTIC's Expert Group, offering reflections, analysis and opinions on the way forward for industry in 2022: "Quite apart from the health aspect, the pandemic has brought in a sweeping change to the economy; some aspects such as teleworking seem to be here to stay. Factor in energy and its management and 2022 looks to be year in which innovation will speed up markedly. Artificial intelligence will come into its own as an across-the-board macro-technology with three trends to the fore: firstly, its application to cybersecurity for a proactive defense; secondly, mobile robotics with highly productive solutions for companies and the public at large; and, thirdly, advanced tools allowing us to cope with today's complex problems by blending physical and virtual resources".

A GMV-led consortium drives research into the application of AI to the agrofood production chain

The GMV-primed AgrarIA project will look into the application of artificial intelligence to the farming production chain to bring about an efficient, productive and sustainable transformation of the sector

A consortium of 24 public-private organizations led by GMV under the aegis of the Digital Spain Agenda 2025 and the National Artificial Intelligence Strategy starts working on the AgrarIA project.

This ambitious project sets out to research the applicability and feasibility of artificial intelligence (AI) together with other Industry-4.0-related technology in real solutions to define new farming production models in order to make Spain's agrofood sector more technological, innovative, sustainable and eco-efficient while also reducing its carbon footprint.

AgrarIA is financed through the Artificial intelligence R&D Missions Program of the Secretary of State for Digitalization and Artificial intelligence (SEDIA in Spanish initials) of the Ministry for Economic Affairs and the Digital Transformation, drawing on funds of Spain's Transformation, Resilience and Recovery plan.

The project focuses on two strategically important lines for the future development of the sector, firstly, research into the complete farming production value chain run by artificial intelligence to slash carbon dioxide (CO_2) output while boosting sustainability, energy efficiency, productivity and competitiveness. Secondly, research into the application of more efficient, carbon-neutral technology and artificial intelligence.

An AgrarIA platform will be set up for standard, single-entity, decoupled-computing integration of all necessary components and models in the farming value chain (production, transformation and distribution). The idea is to define AI-integrated process flows plus other enabling digital technology for rolling out one-off initiatives or specific use cases that favor a fast, efficient, productive and sustainable transformation in the sector's mid-term.

Developed solutions include new natural pesticides and disease-control products that match the effectiveness of synthetic-chemical pesticides and provide a real solution to the Farm-to-Fork and Green-Deal constraints that farmers have to meet nowadays. Collaborative robotics is being used to streamline the product transformation phase while quantum computing research for the management of satellite images is also underway to optimize farming production and digital twinning to ensure energy efficiency of refrigeration plants.

Opinion

Privacy-Enhancing Technologies for the creation of data spaces and secure information exchange

Data is without doubt one of today's linchpins. The proliferation of analytical and cognitive systems has enabled information and knowledge to be extracted from the vast amount of data generated today. Though this amount of data has soared exponentially, it is usually scattered among many different holders. This makes it hard to draw general conclusions; only piecemeal data is ever to hand, describing the behavior or characteristics of only a small sample of existing information. This may well lead to biased systems too, incapable of explaining general behavior fairly and accurately.

The first option we might come up with in search of higher-quality information is aggregation of the data to hand in order to come up with general conclusions. For this to happen, the scattered data sources need to share this data. This is not always possible, however, whether due to confidentiality constraints, strategic limitations or personal- or sensitive-data legislation. This circumstance might clearly hinder the performance of projects of this type, setting up an insurmountable barrier in many cases.

Given this situation, the European Commission is currently drawing up a proposal for a regulation of the European Parliament and of the Council on European data governance (Data Governance Act). The aim of this draft is to set up a framework that encourages a greater reuse of data, increasing its trustworthiness among intermediaries and reinforcing the diverse EU-wide data exchanging arrangements. This regulation will play a key role in shaping a common Data Space to make data findable, accessible, interoperable and re-usable throughout the whole European Union in strategically important sectors such as energy, mobility and health, with knock-on benefits for the public at large in terms of personalized medicine, new mobility and a promotion of the European Green Deal.

As the technological panorama evolves into the future, moreover, cooperation between the various data-holding organizations will become feasible thanks to Privacy Enhancing Technologies (PETs), which protect data, constrain its movement and govern both access and use. This will assuage many of the historic qualms and encourage alliances between the various organizations.

José Carlos Baquero
Director of Artificial intelligence and Big Data
GMV's Secure e-Solutions sector

"Privacy Enhancing Technologies (PETs), protecting data and restricting its movement while controlling both access and use, enable different organizations to cooperate with each other"

GMV wins award for its R&D+i work with UPM

Granted by the Polytechnic University of Madrid (*Universidad Politécnica de Madrid*: UPM), this prize represents acknowledgement of GMV's staunch commitment to university-company collaboration

The Polytechnic University of Madrid (UPM) has awarded GMV the 2021 Award for Research and Innovation Collaboration with UPM. These awards are organized by the university annually to showcase those whose work has made a significant contribution to the University's research, innovation, and knowledge transfer activities, where recipients include both public and private companies, as well as teachers and individual researchers. In this edition, thirteen awards were given in four categories.

The awards were presented on January 28, during the solemn academic ceremony held on the occasion of the celebration of St. Thomas Aquinas in the auditorium of the UPM in Madrid, in a ceremony presided over by the UPM Rector Magnificus Guillermo Cisneros. Ignacio Ramos Gorostiola, GMV's corporate director of People Strategy & Infrastructures, accepted this award on behalf of the company.

GMV arose from the university's school of aeronautical engineering. The cornerstones of technology, innovation, and excellence on which Professor Martínez García founded the company have been sustained throughout all these years and have made the company a leader on an international scale.

This university-company partnership has grown both in the field of innovation and joint research programs, as well as in the training of students through internships in the company and the engagement of company staff in teaching, and the development of educational programs.

GMV welcomes prominent group of former senior executives from the Spanish Administration

GMV was visited recently by a group of people who are or have been members of the Spanish public administration, including senior executives from the ministries of the interior, defense, justice and the press.

The event was kicked off with a general presentation of the company in the auditorium at the PTM site in Madrid, with a brief overview of the company's history, from its foundation to today, highlighting its evolution and rate of growth. GMV's general managers of Defense, Space and Secure e-Solutions showed the guests the company's organization into different activity sectors, as well as the most important references and projects, showing the company's potential in those areas.

Following the presentation, there was a brief talk covering the very latest issues, such as how the Ukraine-Russia conflict is affecting the navigation systems that use GNSS technologies and the added value of PRS technology (Regulated Public Service) in overcoming problems related to jamming and spoofing detected by the European Security Agency during the conflict the week before the meeting (March 14-18).

Those in attendance were also interested in matters related to the company's property and its collaborators, showing great interest in the issues covered during the visit and stressing the company's capacity for innovation and its international presence.

Interministerial Delegation visits GMV's Valladolid site

On January 13, a delegation of representatives from the Ministries of Transport, Mobility and Urban Agenda (MITMA), Defense (MINISDEF) and Industry, Trade and Tourism (MINCOTUR)—all members of the interministerial committee of the Galileo Program—visited GMV's facilities in the Technology Park of Boecillo (Valladolid).

GMV took the opportunity during the visit to show off the different working environments and the equipment of these facilities, enabling it to develop its intelligent transport system products with the most rigorous quality and control mechanisms.

In addition to product-level work, various representative projects were presented in the railway transport area, highlighting the excellent collaboration with the main players in the sector among the company's clients, as well as projects in the automotive and mobility area, including the GNSS-based infrastructure pay-per-use solutions that GMV has been working on for several years, and the Enhanced Galileo Green Lanes project for monitoring traffic on the borders of the Trans-European Transport Network (TEN-T), a project for monitoring traffic on the borders of the Trans-European Transport Network (TEN-T).

As a result of the visitors' interest in the projects and expertise in the various technologies presented, follow-up and extension meetings have been proposed to several members of the management teams in the various ministries represented within the framework of support to the Spanish transport industry.

The members of the interministerial committee assessed the visit very positively, highlighting the good impression made by the quality of the work and team spirit of GMV's members, underlining their enthusiasm, dedication and excellence.

GMV's staff once more shows its charitable side, backing the Food Bank

For the second year running employees of GMV and the firm itself have shown their charitable concern for the disadvantaged, giving the Food Bank a donation of €50,000 in 21,500 Kg of food.

The sixth COVID-19 wave is hitting disadvantaged families hard, many of them becoming dependent on charitable organizations like the Food Bank. Firms like GMV cannot stand by with arms crossed, especially after hearing that the Food Bank's input fell by 44% over the last year, while demand soars.

This fellow-feeling chimes in perfectly with GMV's corporate core values of generosity, cooperation and commitment to the less well-off. Once more, therefore, the firm is supporting the Food Bank's unflinching philanthropy. During 2021 the firm itself and its employees have taken part in several charitable activities to try to offset the pandemic's devastating effect.

The donation was delivered on January 19 by Ignacio Ramos Gorostiola, corporate director of People Strategy & Infrastructures at GMV, on behalf of the company and its employees.

GMV joins "Tu Carrera Digital" program

With the aim of fostering young, stable and quality employment, GMV has recently joined "Tu Carrera Digital" (Your Digital Career) program, a training initiative launched by Adecco that intends to train more than 3,600 young people aged 16 to 30 in digital skills.

Driven by Red.es as part of the training program for youth employment in the digital economy, this will be one of the largest training and employability projects for young people in the coming years.

The aim is to train young residents across Spain in digital and innovative occupations, in order to meet the high demand for digital profiles made by companies such as GMV.

As one of the program's collaborating companies, GMV has been involved in identifying the current needs of both the labor market and professionals in order to design the initiative's training plan and programming. Drawing on its experience with similar initiatives, GMV has contributed its knowledge to the plan's design, with the aim of increasing the skills, competencies, and qualifications of the young people who enroll in the program. On completion of the training program, GMV will look to recruit any profiles that fit its needs.

The intergenerational handover, a perk of GMV's diversity strategy

Diversity has huge knock-on benefits; it drives creativity and innovation and it nourishes budding talent. As such it has become one of main priorities of most companies. They say that experience is worth any degree, but experience per se is no guarantee of higher quality work. GMV promotes intergenerational diversity as a bonus in its teams and therefore in our projects. Junior staff can learn from the senior, longer-serving staff not only how to get things done but also how to go about them, i.e., the attitudes and values over and above their academic training that can only be learned on the hoof.

Quid pro quo, the junior staff generally help to keep company teams in touch

with the changing world and show how technological evolution is an unstoppable force. Indeed, many of the juniors' jobs did not even exist only a few years ago and have now become essential for the teams' ongoing growth and development. Those lying between these two extremes, the mid-seniors who joined as juniors and are now on their way to becoming seniors in their own right, also find a personal and career stimulus for their own growth.

With the aim of continuing to grow and improve in the management of generational diversity, three GMV employees explain below what they get out of this stimulating mix of experience in terms of higher productivity and greater enrichment.

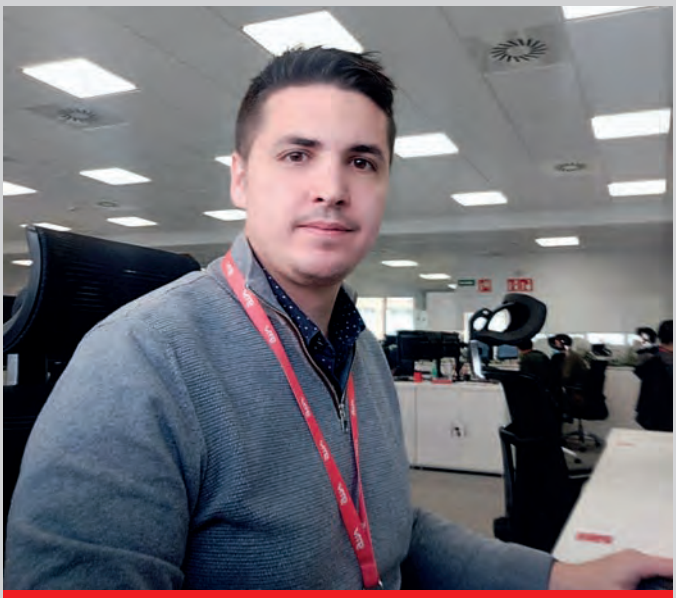
Gustavo García – Senior profile

I've now been working 24 years for GMV. My most recent activities concentrate on the design of electronic equipment (wearable computers, power electronics, FPGAs, etc) and also the development of communications software, which is something I've been working on almost since my start in the firm. The technical complexity of these developments calls for a great problem-solving capacity, with the requisite knowledge to analyze the problem properly and the imagination to then come up with the right answer.

The experience I've built up in GMV over these years has given me an overview of all development aspects, enabling me to zoom in on the most complex or time-consuming tasks from the very first moment. This is vital in order to minimize the associated risks of any project.

To my mind it is important to dedicate a certain amount of work time to mentoring the more junior staff. They need to be shown those aspects that will be most con-ducive to their best performance and medium- or long-term career development.

It is important to remember too that any firm like GMV, whose main value is knowledge, calls for an effective transfer of information from the most- to least-experienced to keep up overall knowledge levels within the company and ensure it is enriched with the experience of each employee. This is precisely why GMV's most experienced personnel should be mindful of our responsibility in this sense, and re-member that knowledge must never become a closed shop.



Carlos Molina – Mid Senior profile

I started working for GMV in 2013, after finishing my aeronautical engineering studies. After a brief stint in the Tres Cantos office, I moved on to the Airbus site (Getafe). After this experience I then moved back to GMV's home site, joining the avionics team within GMV's defense and security sector. Throughout these years in GMV I've gained a good grasp of the various, enriching points of view, whether posted to the client or working on the company's own site.

In my day-to-day work I use many different working tools, each one geared towards one of the tasks I have in hand at the time. These range from software development tools to project management tools. As well as the right tools, I regard it as essential to know how to get the very best out of each resource and be organized enough to be able to juggle a high number of tasks at the same time. It's important too to keep an open mind, in order to come up with trailblazing solutions that best suit each of the problems we have to deal with daily in GMV.

In the various projects and teams I've formed part of in GMV, I've always tried to input my analysis- and coordination-skills to help find the best solution in each case. But it's not all one way; I've also learned and been enriched by the contributions not only of junior staff, who often have the freshest ideas, but also the senior staff, whose experience has often proved to be extremely useful to me in certain difficult situations.

Last but not least, I'd like to stress the importance of ensuring the transfer of knowledge within the working teams. My team in particular has always advocated and encouraged the drawing up of manuals and archives with bibliographical references associated with the most important technology applied in our projects.

Martín Bárez – Junior Profile

I started working for GMV in May 2021. My daily work involves designing FPGA applications. FPGAs are a special type of chip that can change their internal structure to suit the task in hand. They are normally used for aerospace applications or signal processing and cryptography, for reasons of security and latency.

To develop them you have to be very organized and also know how to define requirements and interfaces from the get go. FPGA technology also represents a paradigm switch from standard software; the whole code is run simultaneously in each clock cycle, whereas in a normal processor the instructions are run sequentially one after the other.

I see my trump card as the calm way I go about things. Our project was missing a complex interface. It threatened to be very time-consuming and certainly with no guarantee of success. Anyway, I got down to it and now we enjoy a much bigger bandwidth in our product. I'm very grateful to my boss for trusting in me and letting me show I know how to tackle complicated problems.

This MO is fine when you're working alone. But if there's one thing my colleagues have taught me it's how to work with others, inside and outside GMV, and with clients. This is essential not only for setting demonstrable milestones but also for managing expectations, calculating development times, etc.

I rate my time at GMV very highly, as well as the tasks I've been trusted with. Although some documentation-type tasks have been somewhat tedious, I also think I've learnt a lot from them.

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