News

No. 83

gmv INNOVATING SOLUTIONS

Satellite navigation, a vital infrastructure management technology

INTERVIEW
Isabel Pardo de Vera
Secretary of State for Transport, Mobility and the Urban Agenda of the Government of Spain

Rail Live 2022

29 November - 1 December
Malaga, Spain

GMV will be attending a new edition of "Rail Live", to be held in Malaga (Spain).

GMV's stand (No. 38) will be displaying its railway transport systems solutions, such as the Automatic Vehicle Location System (AVLS) for the ***SAE-R®*** rail environment, which provides operators with integral management of the transport service, from real-time service compliance control to business intelligence tools, as well as resource dispatching, alarm management and regulation tools, among others.

GMV will also show its ticketing systems, including access control systems in stations and onboard or platform validation systems (especially in streetcars) and ticket vending machines onboard and in stations.

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Letter from the president

"KITT, I need you buddy" David Hasselhoff would say to this watch in the eighties TV series Knight Rider, whereupon his fantastic driverless car would screech to a halt by his side.

What was pure sci-fi back then is now much closer to becoming an everyday reality. We're used to talking into our watches. Some of our cars are also starting to understand us. And our cellphones afford us what is practically a sixth sense: localization combined with internet access. With the cellphone turned on we don't get lost any more, and we can even check out our surroundings without moving from the spot. Since 2018, moreover, all new cars have their own localization and mobile-communications devices to alert emergency services in the event of any accident using the eCall system. Meanwhile, GNSS localization services are continually improving and adding new features, with a key participation of GMV in the ground control segments, mission control and service centers of Galileo.

GMV's wealth of experience and in-depth knowledge of GNSS systems has also enabled us to develop inhouse solutions adapted to meet the specific needs of industrial, aviation and automotive sectors, which depend not only on highest precision, but also demand cast-iron reliability to guarantee that the indicated position always matches the real position within stringent confidence intervals.
To pull this off, GMV has set up a GNSS signal correction service that accounts for satellite position deviations, atmospheric distortions of GNSS signals and other error sources, based on data from GMV's own worldwide network of GNSS stations.

Mónica Martínez

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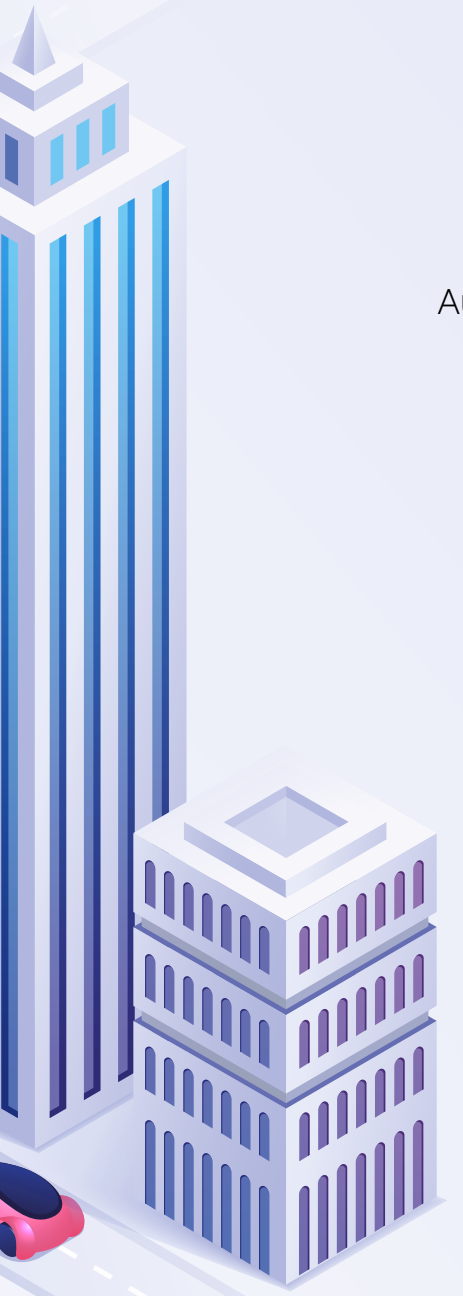

Satellite navigation, a vital infrastructure management technology

Automated driving, smart traffic management systems, mobility smart applications and "mobility as a service" all turn to GNSS (Global Navigation Satellite System) for the highest accuracy and dependability

Nine out of ten of the world's inhabitants breathe polluted air. This takes a yearly death toll of seven million people, according to figures published by the World Health Organization (WHO).

Spain's Climate-Change Law (*Ley de Cambio Climático*) passed in 2021, stipulated that local authorities with more than 50,000 inhabitants (and those with more than 20,000 if they exceed contaminating particle threshold limits) plus Spain's islands are bound to set up mobility plans by 2023 for the creation of low emission zones (LEZs) that lay down clear emission-reducing measures while also helping to mitigate climate change.

The LEZs' main remit is to limit access of the most polluting vehicles to certain areas demarcated within each local authority, aiming to cut down air pollution and traffic congestion as well as reducing noise levels and improving road safety.

The playing field and game rules seem to have been clearly set out, while there is also a consensus among leaders and politicians that citizen health is a top priority.

TOWARDS MORE SUSTAINABLE AND EFFICIENT MOBILITY

The various cities and local authorities affected by air pollution and traffic congestion have been working away busily on this matter for several months in order to be able to tackle projects favoring the setting up of these clean zones, doing so with the backing of Spain's Ministry of Transport, Mobility and the Urban Agenda (*Ministerio de Transportes Movilidad y Agenda Urbana*: MITMA). MITMA has by now organized several LEZ-deployment activities while the Environmental Transition Ministry (*Ministerio de Transición Ecológica*: MITECO) is working on the decree that will govern LEZs' features and setup.

Promising and forward-looking initiatives have now been set in motion by the main LEZ stakeholders, such as the Network of Low-Emission-Mobility Cities (*Red de Ciudades por una Movilidad con Bajas Emisiones*), brokered by Spain's Smart Mobility Forum (*Foro de Movilidad Inteligente*). This forum is made up by local authorities, associations, companies and other groupings targeting solutions and strategies to reduce the emissions generated by mobility and their effect on the population.

The final goal of all these activities is to balk LEZ access by the most polluting vehicles while also promoting a renewal and modernization of the vehicles running on our roads, with differential LEZ-access pricing to accustom private-vehicle users to the function and use of these zones.

In recent months we have witnessed an avalanche of public tenders for setting up LEZs and other sustainability-mobility measures in cities. These tenders will make first-call use of 1 billion of the 1.5-billion-euro Next Generation EU funds earmarked for these measures. In late July 2022l MITMA published a new call requesting aid for setting up LEZs and the digital and sustainable transformation of urban transport and mobility, allowing interested local authorities to take up the remaining 500 million euros of Next Generation EU funds.

UPCOMING MOBILITY REFORMS AND THE ROLE OF TECHNOLOGY

Many are the technologies that can be called on for setting up and running LEZs and controlling vehicle access to given areas, although camera-based and license-plate-recognition systems seem to be the most popular by an overwhelming majority.

Some cities, like London or Oslo, have been implementing access-control systems for some time now. Others, like Brussels, have decided to go one step further with pioneering schemes like SmartMove, mooted as an answer to congestion in the European capital. Based on GNSS and using the cell phone as support device, SmartMove taps further into the potential of this technology and increases the range of sensors used within it. SmartMove is a citizen-centered project that calls for no costly devices or camera monitoring but rather facilitates access to multiple mobility services from the palm of your hand.

Increasing LEZ rollout and the promotion of a more sustainable mobility is bound to speed up the advent of the electric vehicle. We should take pause here to think about some of the economic implications of this situation; this is certainly not as headline-grabbing and attractive as the reduction of transport's environmental impact but we do need to give it due airspace; road transport, after all, makes a huge contribution to public coffers.

Road infrastructure currently is funded partly by a tax on the hydrocarbon fuels still being burnt by the immense majority of vehicles running on our roads. By 2050 these are due to have been largely ousted by electric vehicles; this will slash the amount accruing from taxes of fossil fuels, with a concomitant reduction in funds to finance road maintenance, management and improvement.

For this reason and as part of the ongoing drive to internalize many of external road-mobility costs, i.e., making them part of the decision-making processes of transport users themselves, the need has been mooted for several years now of a taxation system that brings the amount paid into direct relation with actual road use, in other words, a pay-per-use system.

Although Spain's draft Sustainable Mobility Law, passed in March 2022, gives no details of a pay-per use system for the country's highways, its wording does help to flesh out a future road-tolling format as well as a new urban-tolling modality.

TOLLING APPLICATION OF SATELLITE NAVIGATION

Zooming in now on the use of GNSS for pay-per-use road tolling systems, right up to national level, this technique is continuing to make headway and inroads. As of today there are 8 European countries running a national geopositioning-based tolling system to calculate the distance covered on the tolling network in question as the basis for charging, and there are several additional countries that are looking into the planning and rollout of GNSS-based tolling schemes.

GNSS road-tolling technology for heavy vehicles (over 3.5 tons) is now being used on the national road networks of countries like Germany, Slovakia, Hungary, Belgium, Russia, Czech Republic and Bulgaria.

Poland has been the latest European country to join the fold, rolling out a GNSS-based system in 2021. Taking its cue from the Czech Republic's system deployed in 2019, Poland will replace its national system based on Dedicated Short Range Communications (DSRC) with a system based on GNSS.

In 2021 Lithuania ran a public tender for an electronic tolling information system, focusing on the system's software requirements rather than the hardware requirements of onboard devices. This is Europe's first national polling system to be based on a smartphone app, representing a watershed moment in the development of GNSS-based tolling systems.

Other countries, like Denmark and the Netherlands, are now looking into the holding of new tenders for this type of satellite-navigation-based schemes, with smartphones and apps to the fore.

Turning to the private sector, we find that leading highway-management organizations have opted for the rollout of GNSS-based tolling systems using the cell phone as their controlling device (as opposed to former projects that called for onboard equipment fitted on the vehicle). Witness "SATELISE®", a trailblazing initiative of CINTRA (of Grupo Ferrovial) jointly developed with GMV. Winner in the "highway" category of the ITS España awards in its 2022 congress held in late April, SATELISE® has been up and running since 2015 and has been successfully

tested in MultiLane Free Flow (MLFF) schemes on several of Portugal's highways.

Looking further afield beyond Europe, tolling based on satellite technology is also making huge strides in Asia: Indonesia and Singapore are Asia's first countries to set up satellite-navigation based systems, with India soon to follow suit. Singapore brought in an Electronic Road Pricing (ERP) scheme in 1998, with an MLFF approach making use of microwave technology. In 2016 Singapore's Land Transport Authority (LTA) awarded the contract for development of the next-generation GNSS-based ERP2 system. In 2023 the new system will replace the onboard microwave device by a satellite unit, thus wiping out the costly dependence on roadside infrastructure.

Indonesia is currently developing a new network-wide GNSS-based tolling system, due to come on stream by late 2022. In 2023 all the toll plazas will be eliminated once the MLFF system is totally operational in the whole highway network. Once there is no need to build more toll plazas, the highway tolling network will quickly expand, growing up to 6000 km in the coming years.

Similarly, India intends to replace 700 toll booths on its national highways with a satellite tolling system, destined to be the world's biggest electronic tolling system with a range of over 130,000 kilometers.

BENEFITS OF GNSS TECHNOLOGY

We therefore see that cutting-edge technology like GNSS is proving to be crucial for the rollout of a whole host of mobility systems. GNSS as by now become a household term thanks to its use in positioning and navigation devices forming part of our everyday world. Its use in national tolling schemes, private highways and other highways run on a concession basis is steadily taking off as its huge technical and economic advantages become all the more evident. Little has been heard, on the other hand, of the

vital role this technology can play in the setting up of LEZs, urban tolling systems and modern mobility services such as central technology, tapping too into platforms that are crucial for the digital transformation of our cities, such as smartphones.

One of the most noteworthy benefits of GNSS is its flexibility. It can be easily adapted to different setups or schemes of the zones managed, applying modifiable criteria or a judicious combination of these criteria (computing of distance covered, detection of presence in zones or "geo-objects", schemes based on the time spent in a monitored zone, etc) without needing to carry out any modifications in the complementary infrastructure.

It's well worthwhile here to bring out the potential importance of the calculation of the distance clocked up within the restricted zones. Vehicles that are theoretically less polluting may turn out in fact to account for more pollution in any one year due to the kilometers they have clocked up in LEZs. Vehicles classed as more polluting, on the other hand, may pollute less if they use these zones only sporadically. It may hence turn out to be possible to propose fairer strategies more in keeping with vehicles' real LEZ use. A virtual GNSS-based odometer can keep track of the distance clocked up by the given vehicle, as opposed to a free-standing system based only on the type of vehicle used.

Another of the advantages of GNSS technology is easy system scalability, enabling the zones to be scaled up or down as need be. The possibility of cell-phone deployment means too that the system can be quickly set up even for a large number of users.

GNSS also facilitates cost optimization. Although some infrastructure is necessary for control or enforcement tasks, it is still far less infrastructure-intensive than any other alternative. The lower rollout and maintenance costs help to trim unit costs to the bone.

Finally, relying as it does on such a widespread technology as a smartphone, it gives users access to a huge variety of other beneficial services that act in synergy with LEZs, not only information services but also other real needs of users moving around in built-up environments.

GNSS is a mature, trustworthy and high-performance technology. It has by now been tried and tested in very similar conceptual schemes, such as national road user charging schemes (Toll Collect in Germany, Skytoll in Slovakia and Viapass in Belgium) and it is present in any smartphone.

A LONG TRACK RECORD AND A WEALTH OF EXPERIENCE

Since early 2000 GMV's inhouse developments have proven GNSS to be ideal for road user charging applications; the company has brought out essential patents related to its use in services implying payment calculated on the basis of positioning or similar information.

GMV has also taken part in the definition of standards dealing with performance features to be met by road user charging infrastructure, involving various technologies, including GNSS. Witness ISO 17444 or the independent group GMAR (Global GNSS Metering Association for Road User Charging).

For years now GMV has been successfully applying GNSS to road user charging and access control in a varied range of projects, such as the ARENA program in Sweden, which looks into GNSS use for road user charging of heavy goods vehicles. Another example might be the tests conducted under the feasibility study of the ABvM system in the Netherlands, weighing up GNSS performance for a road user charging system for all vehicles (private and commercial). Yet another example would be the GINA project, cofunded by the European Union Agency for the Space Programme (EUSPA), under which mass testing was carried out on 100 vehicles fitted with GNSS devices for 6 months. These tests proved GNSS's ability to meet the most stringent positioning demands for payment systems of this type.

GMV has become a technology partner of major infrastructure operators and managers, such as CINTRA, helping them to roll out solutions such as the aforementioned cell-phone-based SATELISE® project.

A UNIQUE OPPORTUNITY

With the current approach it's unlikely that the current widespread infrastructure investment for the necessary mobility services will have time to break even. In very few years, after all, most will be available onboard the vehicle itself, given its built-in connectivity. Vehicles are being electrified and automated too, and increasingly interconnected, so the cell phone is the ideal instrument for transition towards the onboard features we are soon to see on the vehicles running on our streets.

A smartphone gives access to a set of citizen services (not only information, toll-management and LEZ services) to facilitate free movement and flawless mobility based on a completely digital system.

We are now faced with the challenge of becoming a densely digital country, with mobility as one of the main vectors for achieving this. Today's situation should be seen as a unique opportunity, not only for contributing towards the climate-change-mitigation sustainability of transport and mobility but also for winning Spanish cities and towns and Spain itself pole position in transport innovation and making it a champion of mobility digitalization of people and goods.

We need to dare to innovate while also guaranteeing the economic efficiency of the technological options chosen, which have to be of unimpeachable reliability. This is where GNSS really comes into its own.

Last but not least, it is worth stressing the economic benefit of promoting technology like GNSS and transport digitalization. The market of GNSS-enabled devices (including smart phones) has taken off in the last decade; the income from GNSS services is now expected to soar from about 73 billion euros in 2021 to 250 billion euros by 2031, with a CAGR of 15%, and with mobility applications as the main driving force. Automated driving, smart traffic management systems, smart applications and "mobility as a service" all turn to GNSS for the highest accuracy and dependability.

Spain could and should play a crucial role in the new mobility. It now boasts a stable of organizations, including GMV, of great standing and experience, capable of developing technologies that will be crucial in the near future. This is a challenge we cannot afford to shirk.

Isabel Pardo de Vera

Secretary of State for Transport, Mobility and the Urban Agenda of the Government of Spain

Born in Lugo in 1975, she graduated as a civil engineer from A Coruña University in July 2001.

After working in the private engineering sector and a consultancy of road and railway infrastructure projects, she joined ADIF, Spain's Railway Infrastructure Administrator, as a new public functionary in 2007. From that moment until 2015 she held successive site management posts as well as infrastructure manager and construction manager of the Madrid-Galicia high speed railway. At the end of this year she applied for leave of absence from ADIF and was appointed Infrastructure and Mobility Manager of the Provincial Council of Pontevedra.

In June 2016 she rejoined ADIF as the organization's number two, combining the posts of ADIF's General Operations and Construction Manager and General Manager of ADIF High Speed, holding both posts until June 2018 when she was appointed president of both corporations, holding this post in turn until her appointment as Secretary of State for Transport, Mobility and the Urban Agenda of the Government of Spain.

As ADIF president she was responsible for driving the deregulation process demanded by Europe, bringing in new stakeholders to the high speed railway segment. She also played a key role in the development of Spain's local and commuter network, Cercanías, of the freight railway traffic plus a new multimodal concept that now governs the activities of the ministry where she now holds the position of number two, with railways at the hub of sustainable, safe and connected mobility.

Her career recognition includes the Monforte Railway Prize 2018 and a Medal for Professional Merit from Madrid's Civil Engineer Association (*Colegio de Ingenieros de Caminos Canales y Puertos*) in 2019. She was also awarded the Gold Medal of the city of Vigo in 2022.

Practically your whole career has been linked to infrastructure management and you have been a stalwart champion of railway deregulation. How would you weigh up the current railway market deregulation process in Spain to date?

Deregulation in Spain has been a success. We now have AVLO, the low cost carrier of Spain's national network RENFE, plus OUIGO, the low cost carrier of the French network SNCF which has just started trading in this same corridor. True it is that we are still waiting for the entry of IRYO, due to occur later this year, but we can still safely claim, on the basis of last summer's ridership figures, that High Speed has by now fulfilled all our hopes.

And not only in terms of deregulation. The figures of the Galician corridor, which we have just inaugurated, tell us that the public is buying into this form of mobility. And this is particularly satisfying for someone like me who has spent a good part of her career advocating and promoting this mode of transport.

The Europe-wide sector is now facing new challenges, such as sustainable mobility, the digitalization of Green Lanes. How does Spain stand in comparison to other EU countries? How is the secretariat tackling these new challenges?

Green Lanes were a direct result of the pandemic, the search for a more coordinated and collective Europe-wide approach to cross-border transport at a crucial time. They were designed on a European scale to protect workers of the transport sector, who were in the front line of this crisis. All the key border-crossing points of the Trans European Transport Network (TEN-T) were designated as "Green Lanes" open to all freight vehicles regardless of the goods carried. They were important in an environment of general constraints and we now have to work on in order to continue promoting road freight transport sustainability and improving working conditions. Under this umbrella initiative falls Spain's Plan Impulsa while agreements reached by the National Road Transport Committee (*Comité Nacional de Transporte por Carretera*) have spawned a crucial set of one-off and structural measures to ensure an ongoing sustainable sector in environmental, social and economic terms.

There is also a pilot scheme being driven by the president of the government to bring in grain from Ukraine. Although this represents only a drop in the ocean in absolute terms it has been important for Spain insofar as it has made us reflect on the role of railway highways where port capacity has been curbed. In truth the experience of recent years, tough as it was at the time, will make us more resilient, as long as we're capable of learning the salient and salutary lessons from this set of adverse circumstances. And I believe that we in this ministry have done this stocktaking well.

Particularly noteworthy here are the price review mechanisms that have helped to free up public construction activity at a time when executing European funds is top priority. We have been especially keen to meet our commitments to expand High Speed and other railway systems. Noteworthy too were the agreements reached in Spain's National Transport Council (*Consejo Nacional de Transporte*) to improve truckers' activity in times of crisis and prevent the strike from impinging too severely on the manufacturing fabric. Housing measures have also been important, serving as a shield for many citizens, especially now that we are facing an extremely inflationist situation.

Neither should we overlook aspects as important to us as the development of Spain's commuting network, Cercanías, which acts as a real driving force in many major conurbations, or measures such as free medium-haul and commuter transport in Q4 of this year, with a direct knock-on effect on household economies and helping directly to curb inflation.

We are now moving towards a situation in which mobility is going to be increasingly safe, sustainable and connected

We are now moving towards a situation in which mobility is going to be increasingly safe, sustainable and connected, with the railway at the hub of mobility without necessarily downplaying the complementary importance of other means of transport.

As for digitalization, there is no way of achieving smart mobility without data. Work under this heading is already underway with our Big Data project, drawing on Hermes as a fundamental tool in information display and planning. Maybe digitalization is not this ministry's most headline-grabbing work but I would argue that it is bound to play a crucial role in the future, to make sure planning is an increasingly sound and technical procedure.

Spain's draft Sustainable Mobility Law (*Ley de Movilidad Sostenible*) was expected to lay down the future highway tolling format. What it has done, however, is pave the way for a new modality of urban tolling. How is it planned to apply it. How will it be run?

I would argue that "future highway tolling" is not the best way of referring to it. Although not included in the draft *Ley de Movilidad Sostenible*, we are now working on a way of guaranteeing the ongoing maintenance of Spain's magnificent infrastructure. This maintenance is a huge outlay and must be freed from political cycles and the ups and downs of state budgets.

We are now working on how to respond to European demands for a fair pay-per-use concept with upkeep funded by those who most use the roads. We always prefer to use

this term “pay-per-use” rather than “tolling”, especially as there is as yet no firm consensus on how to carry it out. What I can safely claim is that we are listening carefully to everyone with anything to say on the subject and especially the freight transport sector, with which there is a commitment to reach an agreement come what may.

As for the urban areas and Low Emissions Zones (LEZs), the draft *Ley de Movilidad Sostenible* does indeed empower local authorities, if they so wish, to set up special road user charges for vehicles that exceed given limits or maximum free-circulation LEZ categories, following the example of many other European cities. But it is important to remember here that they are only empowered to do so not bound to do so. The final decision about how to apply it is always up to the local councils.

Until now Next Generation EU funds were an opportunity we can’t afford to pass up. Today I can safely say we are turning them to the best account possible

This law does not go into any detail about the pay-per-use system for high-capacity roads but the wording of the draft does lay down the first steps for its application. Has the Spanish government any timeframe in mind for setting up schemes of this type to guarantee road charging in keeping with a sound upkeep of Spain’s roads?
By the end of this legislature I would like to have at least a plan in place of how to go about it, a roadmap with enough of a consensus behind it to ensure cross-party support.

The Transport Ministry is one of the most favored by Next Generation EU funds. What opportunities would you pinpoint for the sector in general? Which type of measures, areas or projects will be subsidized with these funds?
Until now I’ve always said they were an opportunity we can’t afford to pass up. Today I can safely say we are turning them to the best account possible. Spain’s Resilience, Transformation and Recovery Plan (*Plan de Recuperación, Transformación y Resiliencia*: PRTR) will now be a huge boon during the 2021–2026 period; MITMA and its group will input an investment of over 7.5 billion euros into Spain’s transport system.

It’s not down to luck but rather forward-thinking that Spain has been investing for years in High Speed trains despite all the flak this has attracted. European funds – and not only the PRTR but also other mechanisms – are going to help set up this transport mode definitively in coming years. True it is that some citizens in more peripheral areas who have been left behind by the successive crises and who are suffering from a certain dearth of planning have reasons to be skeptical.

Take the example of the Leon-Asturias Pajares high speed line to be brought on stream next year, slashing travelling times and extending Spain’s high-speed network (AVE) to Asturias. And many Asturias citizens probably don’t believe it yet. Why? Because no one has kept their word before. Just as the Galician population in the NW corner never dreamt we could provide a 3-hour Madrid-Santiago run, and now it’s readily available on RENFE’s website.

We’ll get to Almería in the opposite SE corner by 2026 and we are still working on Extremadura’s network, not only to ensure them the advent of High Speed but also that the various breakthroughs will meanwhile have a direct impact on traveling times. The opening of the Plasencia-Badajoz line alone, even though electrification is yet to be phased in over the coming months, has already cut down the Madrid-Badajoz traveling time by 50 minutes. Is this High Speed? No. Were there some teething problems? Yes. But we will never slack in our endeavor to make sure that each ongoing network improvement has immediate benefits for all would-be passengers. Luis Landero said in a recent hard-hitting

address in Extremadura that politicians will go to hell for their failure to bring a decent train service to the region. All I can say in reply is that there is some justification in his complaints, but that many people, me included, have been working hard to ensure we don't go to hell.

Under the Urban Agenda heading, moreover, we are now running a social and economic recovery program to refit residential areas, another social-rental housing program with energy-efficient buildings, the Public Building Refit Program (*Programa de Impulso a la Rehabilitación de los Edificios Públicos*: PIREP) plus the promotion of local pilot schemes under Spain's Urban Agenda.

It's easy to see the impact these initiatives represent, especially when we add to the mix the Youth Rental Discount Scheme (*Bono de Alquiler Joven*) and significant legislative tweaks like the regulation of tax deductions, amendments to Spain's Condominium Law (*Ley de Propiedad Horizontal*) to encourage condominium refits and reforms, the Architecture Quality Law (*Ley de Calidad de la Arquitectura*) and the draft Housing Law (*Ley de Vivienda*).

The European Union has laid down clear sustainable-mobility and energy-efficiency requirements, and initiatives are now underway towards that end. Will this make it necessary to adapt today's infrastructure?

Infrastructure has been continuously tweaked and improved in recent years. What I can safely say, without the least desire to rub anyone's nose in it, is that everyone who argued that High Speed was an expense rather than an investment has been proved wrong.

Indeed, we are currently setting up the legislative framework to allow ADIF, RENFE and any other operators who wish to do so, to make further headway in generating their own power by way of alternative energy sources; this strikes me as fundamental in today's environment. Our trains will increasingly be powered by the sun and wind. If to this we add the interest in trying out hydrogen-based technology, the development of the electric car – with the concomitant need for recharging infrastructure – and the endeavors of aviation and sea-transport firms to seek out and take up new technology of cleaner fuel, which also call for structural investment, I believe we have a thrilling future ahead of us.

As for the electric vehicle, we are now at a crucial juncture. How does Spain stand, in relation with other European countries, in terms of making preparations for recharging infrastructure to guarantee that electric vehicles running on our roads can be charged up in a reasonable time?

This is a constant concern, especially after the refueling snags we saw for the first time this summer. I remember an image that struck me in these months: a person charging up an electric car with a petrol-driven generator. When speaking of the importance of road upkeep and pay-per-use we also have to think about whether we should take advantage of this change to transform our electric-vehicle charging infrastructure. We are in a moment of transition and need to take fleet-footed and sound decisions that will stand us in good stead in the future.

The connected and autonomous vehicle is also being given a big push. Roadside infrastructure will also be important here. How does road infrastructure need to be adapted to cater for the advent of these vehicles and how is Spain addressing this challenge?

Spain's Mobility Law (*Ley de Movilidad*) takes onboard the sector's demand for setting up a series of controlled testing spaces or regulatory sandboxes to dry-run innovative technology that is working towards this end. These are a necessary resource if we want to have an innovation-friendly legislative framework that comes up with answers to the groundbreaking challenges being thrown up by the digital era. This allows us to boost regulation while we learn from technology, and ensures we do so on the basis of real data rather than guesswork.

GMV at UNVEX'22

From 14 to 16 September GMV participated in UNVEX, an event focusing on remotely piloted systems, was held for the seventh time this year from 14 to 16 September at the fairgrounds in Seville. GMV took part as an exhibitor in this three-day event, which featured conferences, exhibitions and demonstrations, bringing together the leading stakeholders in these systems, whether for use in the air (remotely piloted aircraft systems: RPAS), on land (unmanned ground vehicles: UGV) or in maritime areas (unmanned surface vehicles: USV; and unmanned underwater vehicles: UUV).

UNVEX'22 was an opportunity to gather and paint a comprehensive picture of the latest technologies, the creation of steady demand, and investment in the drone sector. GMV presented its aeronautical solutions, notably its developments in intelligence, surveillance, and reconnaissance (ISR) systems, as well as the unmanned platforms SEEKER, PASSER, and SOLO designed and developed by GMV and Aurea Avionics.

One of the highlights of the event was EURODRONE, a program in which GMV plays an important role thanks to a contract to supply the ground-based flight control computer.

It also exhibited its CSD-SIERRA and IRIS systems, designed for the exploitation and distribution of data from remotely piloted systems for the sake of joint intelligence, surveillance, and reconnaissance (JISR). The CSD-SIERRA solution is part of the SAPIIEM system developed for NATO. Meanwhile, IRIS is integrated and operational in the RAPAZ program run by the Spanish Ministry of Defense's Directorate General of Weapons and Material.

UNVEX is a biennial event organized by IDS with the support of Spain's Ministry of Defense and Ministry of the Interior.

GMV wins the contract for the Eurodrone Program Ground Flight Control Computer

The company will develop a critical system to manage all the flight commands from the DUO (Designated UAS Operator) to be sent to the UAS

GMV has been awarded a contract for the design, development, production, and logistic support of the Ground Flight Control Computer (GFCC) for the Eurodrone Program, thus providing AIRBUS with a reliable safety critical computer to command and control the Eurodrone Unmanned Aerial System (UAS).

The Eurodrone Program is undoubtedly the most challenging cooperation program within this kind of airframe. Born as an agreement reached by the European Council in December 2013, it has among its main objectives to provide partner nations with an air strategic/operational system with state of the art JISR capabilities. Such goal is achieved by means of an UAS capable of flying up to an altitude of 13 Km with maximum speed of 500 km/h and a maximum flight time of 18 to 40 hours, depending on the mission profile.

The GFCC is a DAL-A safety critical system in charge of managing all the flight commands from the Designated UAS Operator (DUO) to be sent to the UAS, as well as displaying systems information so that the DUO has accurate data to perform the mission. Eurodrone is designed for flight in non-segregated airspace, and in order to meet the demanding safety requirements several GFCCs are installed in every Ground Control Station (GCS).

Each GFCC has several boards, COTS and bespoke, within a 19" chassis. GMV will be responsible of the production of all items, the qualification test campaign and the acceptance tests, which include burn-in test procedures.

One of the tasks to be performed by GMV is to adapt the BSP, FPGA and drivers of these boards so that they fulfill new requirements and can be certified according to DO-178C and DO-254 DAL-A.

This contract constitutes one step ahead for consolidating GMV as a reference provider for Critical systems for UAS.

GMV plays a key role in ESA's Navigation Innovation and Support Program

GMV's Spanish and UK offices play a key role in the three elements making up the program

ESA's Navigation Innovation and Support Program (NAVISP) has been active since 2017, and is focused on innovation in Positioning, Navigation and Timing (PNT) technologies. It consists of three elements:

- Element 1: Innovation. Fully funded by ESA, activities are issued through Invitations To Tender (ITTs) and aim to develop innovative concepts, techniques, technologies, and systems related to the PNT sector along the entire value chain.

- Element 2: Competitiveness. Co-funded by ESA, activities are proposed by industry with the aim to maintain and improve the capabilities and competitiveness of the participating states' industry in PNT.

- Element 3: Support to Member States. Fully funded by ESA, activities are proposed by consortia of entities from a single ESA member state and aim to support national PNT strategies.

GMV has had great success in NAVISP, being comfortably the most successful company in Element 1, running multiple Element 2 projects and participating in several UK Element 3 projects to date. Examples of projects that have now completed are:

- Low-RF Fast Deployable Systems for Emergencies in Difficult Environments: an Element 1 project primed by GMV's UK subsidiary, GMV NSL involving the design, implementation and demonstration of a novel PNT system at UHF and VHF frequencies, based on drone-hosted transmitters for use by emergency services in crisis situations.

- TOWR: an Element 2 project primed by GMV in Spain and involving the development of a time distribution service via optical fibre over the Madrid region, based on time generation from very stable clocks, GNSS time-transfer to UTC(k) laboratories, and White-Rabbit technology.

- GENS (GNSS Event Notification Service): an Element 3 project in which GMV NSL was a subcontractor and provided its GNSS threat detection technology and expertise.

GMV, FrontierSI, Ericsson and Optus prove 5G-based High Accuracy Positioning

The technology consortium made up by GMV, FrontierSI, Ericsson and Optus and its demonstration partners Kondinin, Platfarm and Position Partners have come together to demonstrate 5G-based LTE positioning protocol (LPP) capabilities in field trials and real use cases as part of the 5G Positioning Testbed, a project funded under the Australian Government 5G Innovation Initiative.

GNSS-based positioning is currently the most commonly used technique for calculating absolute positions at user level. Cases needing centimeter-level accuracy call for GNSS corrections to reduce typical errors in the broadcast navigation message and positioning calculation. For years now the distribution of GNSS corrections has been based on Precise Point Positioning (PPP) or Real Time Kinematics (RTK) broadcasts by geostationary satellites (GEO) through the L-band or point-to-point transmissions through NTRIP on the internet.

The 3rd Generation Partnership Project (GPP) sets out to standardize 5G LPP communications, recently including compatibility with OSR corrections for RTK users and SSR with atmospheric corrections for PPP/PPP-RTK users. Both proposals have stoked up interest in 5G LPP as a possible alternative to the traditional PPP and RTK correction broadcasting services.

Under this project 5G-based precise positioning tests have included demonstrations of each of the LPP protocol working modes. Field tests, conducted in Australia, included real scenarios in three areas in which precise positioning is a crucial component: precision agriculture, drone operation and augmented reality. Project results are very promising so far, ensuring significant headway towards future use of 5G technology in high-precision positioning.

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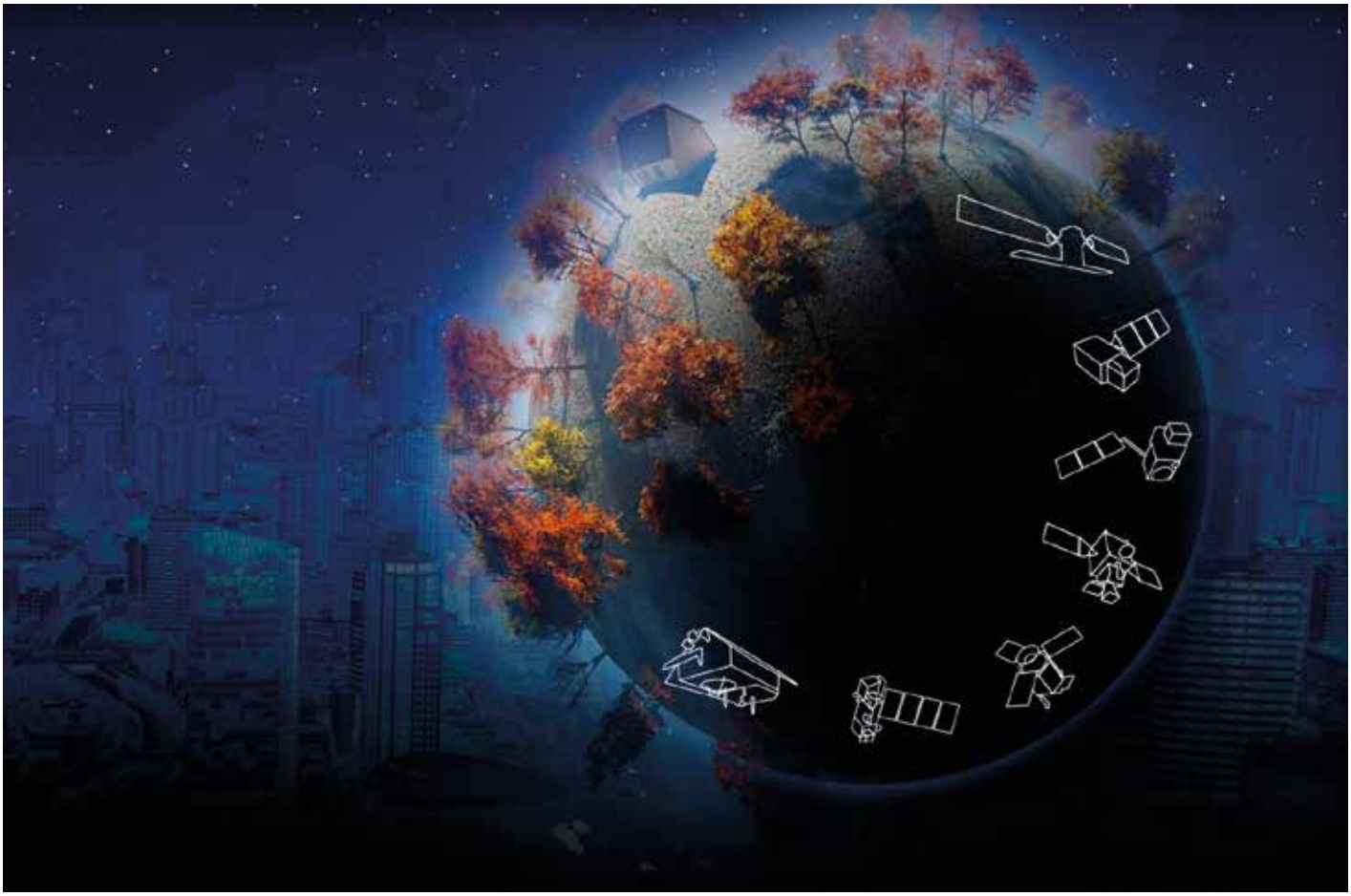
GMV awarded with a renovation of the Copernicus Precise Orbit Determination Service



ESA has awarded GMV with a third renovation of the Copernicus Precise Orbit Determination (CPOD) Service covering 5 years, from 2023 until 2027. The CPOD Service is part of the ground segment of the European Copernicus program, and it is in charge of computing the precise orbits of the Sentinel-1, -2, -3 and -6 missions (7 satellites in total), to support the processing of its scientific data (e.g., Synthetic Aperture Radar and satellite altimetry), requiring accuracies below 1 – 2 cm in absolute positioning.

GMV was awarded its first contract in 2013 for the development and initial operations. The operations were extended until the end of 2022 in a second renovation. During the last eight years, GMV has operated the service demonstrating high levels of performance and service availability and receiving periodic acknowledges from ESA and EUMETSAT.

The CPOD Service is managed and operated by GMV. It is supported by five European institutions (POSITIM, DLR, GFZ, TU Delft and TU Munich), which provide independent products for quality control, and technical consulting to support the continuous improvement of the service.

The CPOD Service is also responsible for the management of the Copernicus POD Quality Working Group, which gather together most of the leading POD centres in Europe and the USA, including AIUB, ESA/ESOC, CNES, EUMETSAT, NASA/JPL, NASA/GSFC, and CLS.

The third generation of the CPOD Service will make use of a new POD software, ***focusPOD***, developed recently by GMV from scratch, using state-of-the art algorithms and computational technologies. This new SW will maintain the current remarkable accuracy, and it will allow the development of new processing schemes based on distributed services / microservices, with the goal of improving the timeliness and the reactivity, while making an efficient use of the computational resources.

The CPOD Service requires precise GNSS orbits and clocks, which are provided by the ***magicGNSS*** correction service. This renovation will make use of the proprietary GMV´s GNSS station network.

GMV technology in communications satellites

In June, two new communications satellites incorporating GMV technology were launched: MEASAT-3d from the Guiana Space Centre in French Guiana, and "NILESAT-301" from the Canaveral Space Center in Florida.

MEASAT-3d is a communications satellite developed by Airbus and based on the Eurostar 3000 platform, for which GMV has been in charge of updating the previous Satellite Control Center (SCC) software, called Real Time System (RTS) and Flight Dynamic System (FDS) which is also based on GMV products.

This update consists of providing the SCC with new versions and elements of the software, along with new hardware for the control center. GMV has deployed new versions of its ***Hifly®***, ***Autofly***, ***Archiva***, ***Flyplan***, ***Focusgeo*** and ***Focuscloseap*** products to operate MEASAT's satellite fleet.

The system includes the redundant satellite operations control center located in Cyberjaya, Malaysia, as well as a non-redundant backup satellite operations control center located in Bukit, Malaysia.

GMV is also participating in the N301 project, which consists of the delivery of a satellite control facility (SCF) to operate Nilesat's two telecommunications satellites: Nilesat-201 and Nilesat-301.

Nilesat-201 has been in operation since 2010 using GMV's technology. With the new satellite, the old system has been updated to also incorporate support for Nilesat-301. From now on, both satellites use GMV products ***Hifly®***, ***Autofly***, ***Archiva***, ***Flyplan***, ***Focusgeo***, ***Centrallog***, ***Flexplan®***, ***Smartrings***, ***SmartHz*** and ***Magnet***.

Nilesat's control center in the Egyptian cities of Cairo and Alexandria, locations that are fully redundant and aligned so that operations can be easily migrated from one to another.

GMV to play a decisive role in Caramuel, the first geostationary quantum key distribution mission

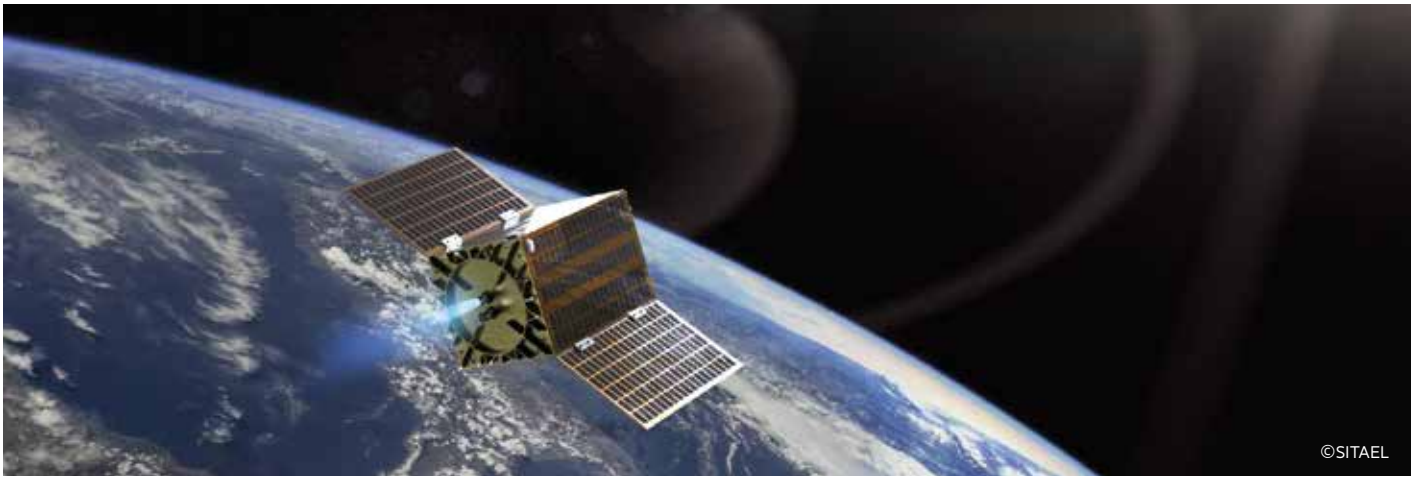
GMV will play a vital role in the Caramuel feasibility study, the world's first ever geostationary orbit satellite mission geared towards quantum key distribution. The study, funded by the European Space Agency (ESA), is backed by a group of Spanish companies and organizations led by HISPASAT, among which GMV holds global responsibility for Caramuel's ground segment.

Quantum computers bring to the table a much higher computational power than conventional computers; this is crucial when solving such tasks as prime factorization as the basis for current asymmetric cryptography. This will involve a paradigm switch in secure communications, so it is now necessary to develop an information sending system with all due guarantees of security.

Caramuel includes a quantum payload onboard a geostationary satellite plus its associated ground segment, for which GMV holds global responsibility. Caramuel is integrated with ground infrastructure for providing a cryptographic quantum key distribution system that is fluid and transparent for final users.

In 2019 the European Commission (EC) announced its European Quantum Communications Infrastructure (EuroQCI) manifesto, which will deploy the first quantum communication nodes in diverse EU countries. These nodes, of metropolitan scope, will be connected up with each other by satellite to guarantee their resilience. The EC's secure satellite communications system missions will include these EuroQCI satellite connections. Caramuel represents Spain's first contribution to these European initiatives. Its top-priority aim is adaptation to quantum communication standards such as the International Telecommunications Union (ITU) or European Telecommunications Standards Institute (ETSI).

GMV wins the contract for the flight dynamics system of PLATiNO's ground system



In late June 2022 SITAEL, primer of the PLATiNO project together with Thales Alenia Space Italy, Leonardo and Airbus, awarded GMV the contract for providing the Flight Dynamics System (FDS) for this mission's ground segment.

PLATiNO is a new platform for mini-satellites developed by this consortium and designed to be adaptable to various missions with different payloads, using a very low-thrust engine for this purpose.

For demonstration purposes two PLT-01 and PLT-02 satellites are to be built, each with a different objective. PLT-01 will demonstrate the platform's capability to carry out precise orbit control maneuvers. To do so the satellite will be placed in formation with another existing satellite, following its same control strategy. At the end of this phase the satellite will be moved into a lower orbit, demonstrating its orbit change capability using electric thrust.

PLT-02, for its part, will be launched later and set up in formation with PLT-01. This case will involve a synchronized orbital control of the two satellites to keep the formation and exchange information by means of diverse sensors. Each satellite, moreover, will carry a different payload: PLT-01 will be fitted with a synthetic aperture radar and PLT-02 with a Thermal Infrared Spectroscopy (TIR) sensor.

After this mission SITAEL expects to be ready to offer this platform for sale to many other missions.

This mission poses many FDS challenges, which GMV will tackle with its inhouse ***FocusSuite®*** product, duly adapted to suit the specific mission needs. ***FocusSuite®*** will not only cater for the satellite's orbit control but will also include all operation automation tools, ***Autofocus*** and 3D display by means of ***Visualfocus***.

GMV presents the UK SBAS testbed at Space-Comm

GMV was present at Space-Comm Expo, held from 7 to 8 September. Space-Comm Expo, supported by ADS, KTN, UKspace, the European Space Agency (ESA) and the UK Space Agency, is a new exhibition held in Farnborough (UK) and focusing on the commercial future of space for business, defense and aerospace.

At this year's exhibition GMV ran a stand showcasing the new UK Space-Based Augmentation System, "UK SBAS", a testbed designed to improve satellite-navigation performance in critical applications. UKSBAS's prime goal is to establish and bring quickly into operation a new national capability, using Inmarsat's current batch of geostationary satellites in orbit (GEO), GMV's SBAS data monitoring and processing software and the Goonhilly Earth Station in Cornwall for SiS uplink to the GEO navigation transponder.

UK SBAS will help to weigh up options for a future operational capacity for providing GPS user augmentation services and potentially other GNSSs.

GMV's stand received many visits at this event dedicated to presentation and demonstration of the UK's SBAS program.

GMV to offer Satellite Operations as a Service

GMV is one of the main references around the world when it comes to the provision of satellite control centres. One of the key of GMV's success resides on the outstanding GMV's COTS products covering each subsystem in the ground segment.

With the Space Operations as a Service project, GMV intends to go one step further in the provision of the hardware and control centre, offering nor only the software but also any service related to it, from hosting to actually operating the Ground subsystems that we have been offering to the market for many years.

The preparation of this service will be a research and development activity in GMV co-financed with ESA through the Advanced Research in Telecommunications Systems (ARTES) programme.

Aiming to enhance GMV's products (in particular the Satellite Monitoring and Control system ***Hifly®***, the Flight Dynamics system ***Focussuite®***, and the Mission Planning system ***Flexplan®***), there are three main challenges to be faced during the project: first of all, the classical monolithic architecture of the products has to be modified and split into a service-oriented architecture, in line with the final goal of the project. The second is improve the deployment of the products, making them fully compatible with public and private clouds and optimising the usage of resources through a Kubernetes-based deployment. Finally, the existing interfaces between the different components are expected to be modernised including a message queue to extend the communication between the different systems.

However, this project does not only include the software development. As part of the service that is envisaged to be provided, the operations of the whole ground segment can be a possibility, since more and more companies are accessing the space market without an actual interest on the satellite operations, but rather in the final products that they can obtain from them.

Considering the wide experience of GMV in the development of its products, operational procedures will be developed to cover the satellite operations, potentially opening a new market for the company.

GMV attends this year's edition of IAC

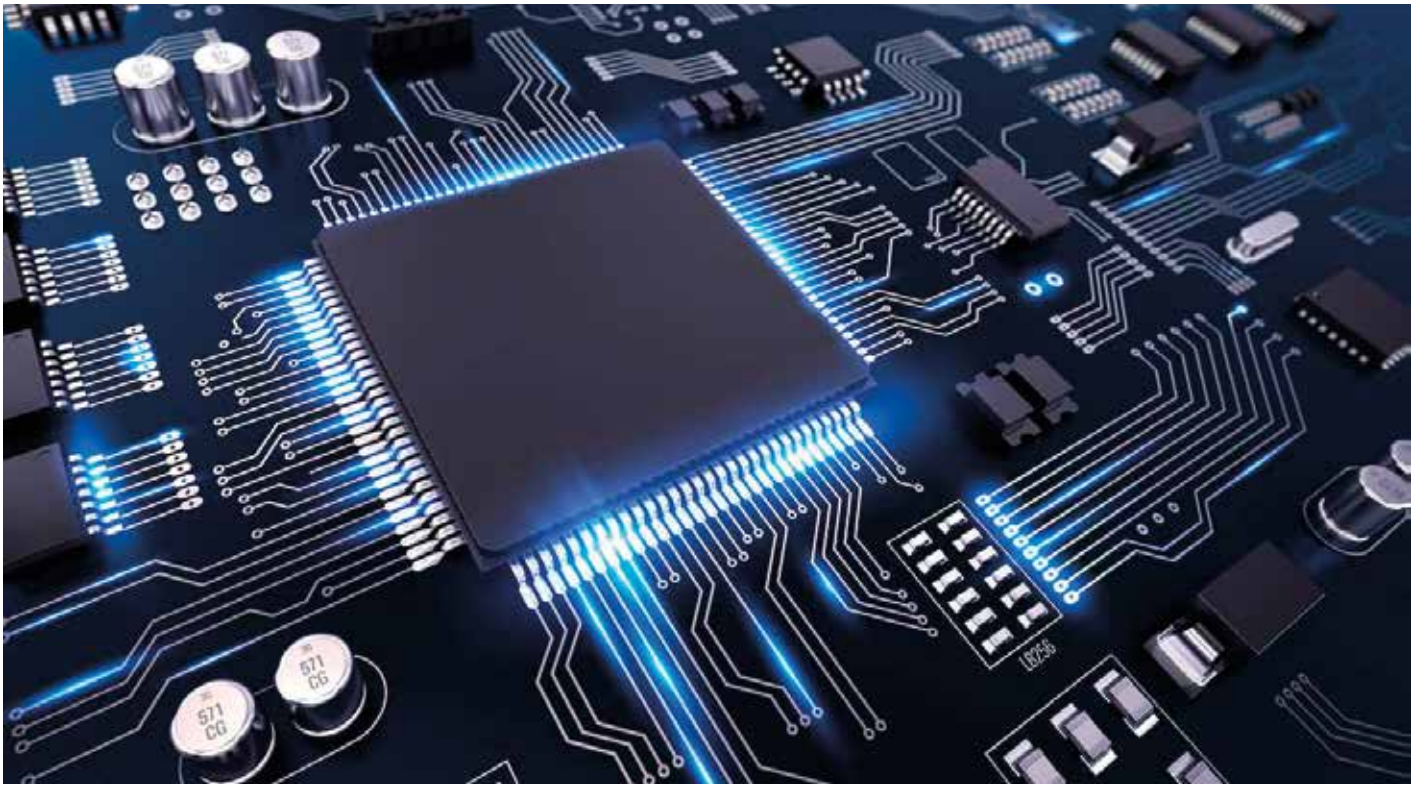
On September 18-22, GMV participated in the 73rd International Astronautical Congress (IAC). This annual gathering is organized by the International Astronautical Federation (IAF) and its partners, and over the years it has become one of the space industry's most important events.

GMV's presence as an exhibitor was especially notable. The company had its own stand, as well as an exclusive space inside the pavilion sponsored by the Spanish government's exporting and investment body (ICEX) and industrial technology development center (CDTI). The company also had a presence at the stand sponsored by the Romanian Space Agency (ROSA). Those in attendance showed great interest in the products GMV had on display, and the company's representatives were able to make some important contacts during the event.

GMV also made some significant contributions to the technical sessions, with presentation of seven articles on a variety of subjects related to space safety and mission planning. In addition, the company actively participated through its membership on a variety of IAF committees, such as those focused on Space Exploration, Planetary Defense, and Industry Relations. Representatives from GMV also led some roundtable discussions during the Solar System Exploration including Ocean Worlds session and the Great Planetary Defense Quiz special session.

GMV's leadership position in areas such as navigation, space traffic management (STM), ground segment, guidance, navigation, and control (GNC), planetary defense, robotics, space debris management and removal, and data processing, have made the company a standout player in the industry, with significant international influence and an important role in the final decisions and conclusions resulting from the congress.

GMV leads SING project



"Single-Chip versatile signal generator suitable for navigation" (SING) is an ESA project kicked off in July 2022 and will be concluded by January 2024.

The objective of SING project is to design a single-chip solution for a versatile signal generator suitable for satellite navigation payloads. Such a design should be flexible enough to generate the main GNSS signals and modulations schemes.

Currently, such flexibility can only be achieved using Field Programmable Gate Arrays (FPGAs) with an external digital-to-analog convertor (DAC) to generate the RF signal. The high data rates in FPGA transceivers and the external DAC implies an increased power consumption in comparison with other non-flexible solutions.

The proposed solution by the consortium is based on the latest generations of radio frequency System on chips (RFSoCs), which provides high flexibility and internal DACs in a single chip and significantly reduces power consumption.

The SING consortium offers a solution based on a team that has extensive experience with the key technologies and areas relevant to this project. The consortium consists of GMV in the UK and Spain as well as the Gdańsk University of Technology (GUT).

The team of GMV in UK is leading the project and mainly responsible for the design of the system, meanwhile GMV's team in Spain main responsibility is the physical implementation of the system and GUT's main responsibility is the system verification and testing.

GMV attends International Space Convention 2022

The International Space Convention (ISC) 2022 took place on 9, 10, and 11 September at the Gökmen Space and Aviation Training Center (GUHEM) in Bursa, Turkey.

GMV took part in this hybrid in-person/online event, which welcomed 80 speakers, including experts and officials from space companies and agencies such as the European Space Agency and the Turkish Space Agency.

The four main topics covered in this first ISC event were space sustainability, Earth observation, satellite market opportunities, and satellite launch campaigns.

Miguel Ángel Molina, Deputy General Manager of Space Systems EST participated as a speaker in two round tables, one on innovation/commercialization in space and another on the creation of a sustainable space ecosystem. He also had the chance to deliver a specific presentation on the future vision of a safer space environment.

GMV attends the latest ION GNSS congress

GMV was present at the latest ION GNSS+ 2022 congress, the world's biggest GNSS technology, products and services exhibition, held from 19 to 23 September in Denver, Colorado.

Organized by the not-for-profit Institute of Navigation (ION), the congress brought together international leaders in GNSS and other positioning navigation and timing fields to present new research, launch new technology, discuss current policies, demonstrate products, and exchange ideas.

Attending the congress onsite once more after the COVID-19 constraints in 2020 and 2021, GMV presented 19 papers as main author and contributed to another six as coauthor. It also ran a stand displaying GMV's inhouse ***MagicGNSS*** family of products plus other satellite-navigation applications and developments, such as GNSS CORS Network, ***MagicSBAS***, ***MagicGEMINI***, ***Eclayr*** and ***Detector***.

In keeping with its satellite-navigation leadership, GMV featured prominently at the event; over a dozen GMV workers took part in all, from the company's offices in Spain the UK and Portugal.

GMV, present at the 32nd RTCM Seminar

GMV was present at the 32nd Thematic Communications Network Seminar (*Redes Temáticas de Comunicaciones Móviles:* RTCM), held on 1 July in the Department of IT Engineering and Technology of Coimbra University's Faculty of Sciences and Technology (FCTUC in Portuguese initials).

Several papers were presented at the seminar after the opening address from Ricardo Conde, president of PTSpace, on the importance of space communications for Portugal.

GMV's Teresa Ferreira took part in the afternoon panel under the title "Space communications, challenges and opportunities", focusing on current satellite communications trends. The panel also featured such issues as space optical communication and examples of deep space missions, presented by the rest of the panelists.

One of the main themes dealt with was the opportunities of LEO constellations for Portugal and today's technology trends, including flexible payloads, SDR networks, mixed network topologies (GEO/ MEO/ LEO) and security issues.

Ground and satellite communication networks are now developing towards mutual complementarity and GMV is well placed to weigh in with its own solutions.

RTCM is a group interested in telecommunications; it is open to researchers, industry professionals and other participants and holds seminars twice a year to swap notes and results.

GMV develops the Space Weather Service Network for Southern Europe users

Under the Space Situational Awareness (SSA) Programme, ESA has set up a space weather service network that monitors space weather and disseminates information and alerts.

This space weather service monitors the space environment and in particular changes from the Sun (or non-solar sources) which can lead to modifications in ambient plasma (such as the ionosphere) or in the radiation of particles and magnetic and electric fields.

These modifications may impact activities on Earth such as creating anomalies in the ionosphere hence impairing GNSS use for aviation or modifications in the geoelectric field that could disturb communications.

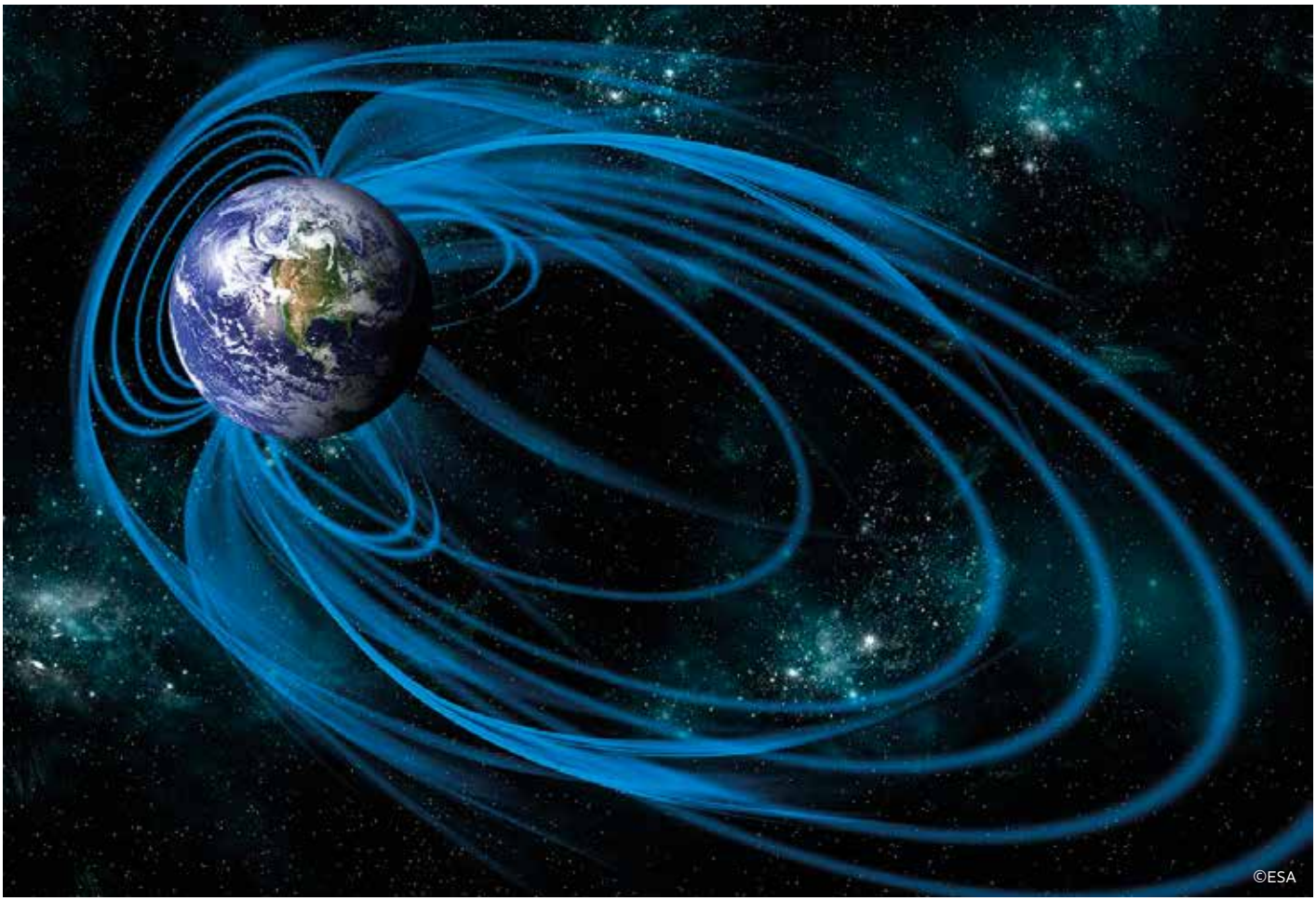
Timely space weather information is valuable for many applications and several user communities are appearing, with users becoming more knowledgeable on potential impacts and interested in mitigating them, e.g. in the field of critical infrastructures.

Space weather varies according to the geographical location on Earth. For example geomagnetic events are more frequent at high latitudes while ionospheric disturbances are less seen at mid-latitudes.

GMV is proud to support the University of Alcalá in an activity to further develop the Space Weather Service Network capabilities regarding end users in the Southern Europe.

From Portugal, GMV will use the data collected from its ionospheric scintillation monitoring station and interact with the University of Coimbra and UPC to assess potential future products that could be useful for the South of Europe.

From Spain, GMV will contribute with the development and calibration of a magnetometer prototype for Space Weather purposes to be deployed at Meson do Vento or Barcelona. The prototype will consist of four modules: the solar panels, the power system including battery and transformers, the magnetometer sensor and the acquisition system with A/D converters, temperature sensor, GPS receiver, and other complementary components.



GMV contributes to development of Portugal's space surveillance system

GMV has signed two contracts with Portugal's Ministry of Defense, focused on research and development for Portugal's space surveillance and tracking (SST) system, which is part of the European Union's SST system (EU SST). This work will address an area of increasing concern, which is the alarming rate of increase seen in the amount of space debris orbiting the earth, caused by the growing number of launches taking place in recent years. The European Space Agency (ESA) now estimates that there are almost 10,000 metric tons of material orbiting our planet, including more than 1 million objects larger than 1 cm in size. This presents a real risk for satellites currently in operation, as well as for those developed as part of space projects in the future.

GMV will be responsible for studying the adaptations and improvements being developed for the EU SST database and inventory, and for studying the impact that those changes could have on Portugal's SST system. In addition, and also in the context of the EU SST program, GMV will be studying implementation of new services and the future space environment. All of this will contribute to analysis of a potential expansion of "basic" services for EU SST (collision, reentry, and fragmentation) and assessment of other new services. It represents a clear opportunity to propose and participate in these new services, and to expand Portugal's role within the EU SST program.

More than 80 engineers from GMV are now working on SST activities in seven European countries, making this a primary area of operations for the company and the largest SST team in Europe.

GMV is a worldwide leader in the study, monitoring, and prevention of space debris, as a way to protect the safety and sustainability of space operations in the future. Much of GMV's work on this subject is dedicated to ESA (in Spain, France, Germany, the United Kingdom, Poland, and Portugal), to the EU SST system (in Spain, France, Germany, Romania, Poland, and Portugal), to the commercial sector (providing collision avoidance services to more than 10 operators and more than 80 satellites through its ***Focusoc*** operations center), and to the field of military space.

International Space University Space Studies Program visit to GMV Portugal

This summer, the offices of GMV in Portugal were visited by the participants of the International Space University Space Studies Program, organized by Agência Espacial Portugal, in collaboration with *Instituto Superior Técnico*. The Space Studies Program (SSP) offers an intensive nine-week course hosted each year in the June-August timeframe in different locations around the world. And this year Portugal hosted the 34th annual Space Studies Program, in Oeiras.

A total of around 150 students of international origin with a very varied background, from engineers, physicists, lawyers, managers, historians, had the opportunity to visit GMV's facilities in Portugal and learn about our products, applications and services.

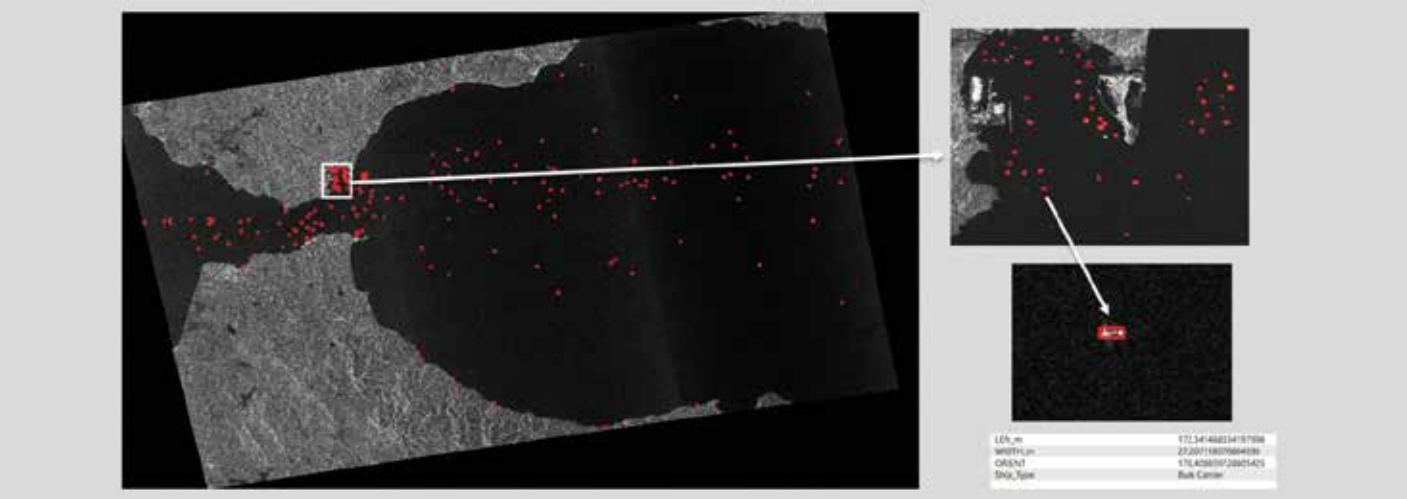
About 40 participants visited GMV in two groups: one with the Space Applications Department and another from the Management and Business department.

GMV presented its background on applications such as space servicing, remote sensing and positioning navigation and solutions. In the end, the participants were split in working groups to prepare a pitch of three new applications using space technology in three domains: land, ocean and space. This workshop process lead to a creative and interactive exchange between GMV experts and the participants

Management and Business department: GMV shared its success growth history from a small company to the 6th largest European group per employment in the space domain in less than 40 years.

Then the participants were split in groups to prepare a pitch on one of GMV products, air – a hypervisor used both in the aeronautical and the space domain. This lead to fruitful discussions about business models related to open source software.

Vessel detection and classification based on application of AI to satellite images



On 14 July the kickoff meeting was held of the Artificial Intelligence Algorithms for Earth Observation Data (AIDA) project, carried out by GMV for the European Maritime Safety Agency (EMSA). AIDA's main aim is to establish a vessel-detection and -classification service based on artificial intelligence (AI).

AIDA is broken down into independent subprojects: AIDA-SAR, based on synthetic aperture radar images, and AIDA-OPTIC, based on passive sensor images.

AIDA-SAR depends on the development of models using SAR images as their training data, such as Sentinel-1, Radarsat-2, TerraSAR-X / TANDEM and PAZ1, while AIDA-OPTIC will be based on the development of models using very high resolution optic images as training data, like Worldview (1, 2, 3, 4), GeoEye-1, Deimos-2, Pleiades (1A, 1B), Spot (6,7).

AIDA's stiffest challenge is to achieve a sufficiently reliable model (meeting pre-established confidence thresholds) that helps, firstly, to identify and separate vessels from other objects on the sea (oil rigs or fish-farm infrastructure, etc) and, secondly, to distinguish the vessel type according to the coding laid down for automatic identification systems (AIS).

Projects like AIDA win GMV pole position in the search for solutions based on new technology and computing tools (such as artificial intelligence and big data) by means of mining and analyzing various remote earth-observation products. The overall goal is to provide support for various monitoring and decision-making organizations of the national, regional or global scenario.

GMV at IGARSS 2022

The International Geoscience and Remote Sensing Symposium (IGARSS) is the flagship conference of the IEEE Geoscience and Remote Sensing Society (GRSS). It aims to provide a platform for swapping notes and experience on recent developments and advances in geoscience and remote sensing technology, particularly in the context of earth observation, disaster monitoring and risk assessment. IGARSS 2022 was held from 17 to 22 July 2022 as a hybrid event. GMV co-chaired the invited session "Earth observation (EO) in support of food security in developing regions".

Sustainable Development Goals (SDGs) aim to guarantee welfare, prosperity and environmental protection. These include SDG2 Zero Hunger (closely bound up with SDG1, End poverty in all its forms, and SDG3, Health), and directly linked to the concept of food security, currently at risk in developing countries due to frequent extreme weather events, plagues, degradation of natural resources and unsustainable livestock-farming practices.

In this context the session brought together worldwide experts to set out recent earth observation breakthroughs and EO use to guarantee food security in developing regions. During this session GMV presented a study on "Earth Observation For Index-Based Crop Insurance in Rwanda", in representation of Clarisse Kagoyire, Rwanda University.

GMV-Led EUSTM CSA Wraps Up with the Celebration of its Final Workshop in Brussels

On the 31st of August, the Space Traffic Management for XXI Century Space Operations (EUSTM) consortium held its final workshop in Brussels. Led by GMV and strategically positioned at the heart of the European Commission´s intensifying efforts to ensure the security, safety, sustainability, and autonomy of European space operations, the EUSTM Coordination and Support Action (CSA) reached the end of its envisaged 20 months of activities aimed at drafting proposals and recommendations for a future European Space Traffic Management (STM) capability.

The EUSTM team involves 18 European industries and institutions with extensive experience in all STM-related areas, ranging from SSA/SST/STM technical experts, satellite operators & manufacturers and launch providers (including relevant actors in the New Space) to policy, governance, strategy, and legal stakeholders. EUSTM analysed the current STM support competencies in Europe and defined the related needs for an autonomous European STM capability by providing technology, governance, legal, regulatory, standardization, strategy and policy recommendations and best practice guidelines.

Counting on a significant in person attendance, this hybrid EUSTM Final Workshop provided the perfect opportunity for the consortium to showcase the main findings of this end-to-end activity, both to the EC representatives and to the European Advisory Board members, also enabling a more direct interaction between the participants present in Brussels.

The extensive effort put by the team in drafting these analyses and proposals was highly acknowledged and a wide unanimity was reached on that the EUSTM recommendations will play a valuable role in supporting the development of the European Union approach to Space Traffic Management.

**This article reflects the author's view and not necessarily the views of the European Commission or of the EU HaDEA Agency.*

GMV takes part in the launch of ESA's new rocket: Vega-C

Among the activities carried out, those related to the development of the rocket's avionics testbed, as well as its qualification campaigns stand out

The European Space Agency's new rocket, Vega-C, was launched on July 13: The maiden flight was conducted from the European spaceport in Kourou, French Guiana, and lasted 2 hours and 15 minutes, from liftoff to payload release and combustion of the upper stage engine.

Vega-C has superior capabilities over its larger and more powerful predecessor, Vega, capable of carrying payloads of up to 2.3 tons into a reference polar orbit at 700 kilometers altitude.

The main payload was LARES-2, the satellite of a scientific mission of the Italian Space Agency (ISA) that has been placed in its planned orbit. Six CubeSats, nanosatellites built with standard dimensions (Units or "U"), from French, Italian and Slovenian research were also transported as secondary payloads.

The total payload mass at takeoff was approximately 474 kg: 296 kg corresponded to the LARES-2 and the rest to the CubeSats, payload adapters and transport structures.

GMV has participated in various activities related with the development of the VEGA-C avionics test bench (HWIL, HardWare In the Loop) and with the avionics qualification test campaigns.

GMV and AVIO engineers in Colleferro worked on the layout design (organization) of the laboratory where the functional tests of VEGA-C avionics are run.

GMV has also been responsible for the design, development and validation of the SEB (Sensors Emulator BOX), test equipment that, at electrical level, emulates the over 300 sensors of the VEGA-C launcher. The system is made up of six different boxes, each dedicated to the stimulation of a telemetry unit, connected by Ethernet links and centrally controlled. By using this system, the telemetry units of the VEGA-C launcher, which are responsible for receiving the sensor signals, can be stimulated coherently with the flight scenario.

GMV has also provided support to the Colleferro team during the execution of some of VEGA-C's avionics test campaigns (such as the test campaign of the avionics communication bus, the telemetry subsystem and the launcher's electrical interfaces).

GMV has also participated in the design, development and validation of the equipment (racks) and cabling needed to interface between the different equipment of VEGA-C's HWIL laboratory.

GMV leads ESA's auroral oval monitoring study

One of the most relevant areas within ESA's SSA program is the Distributed Space Weather Sensor System (D3S), aimed at monitoring the Space Weather (SWE) effects in Earth's vicinity. The implementation of D3S will be based on a combination of hosted payloads and small satellite systems, providing different measurements. ESA has decided to re-orient the scope of one of the envisaged small satellite missions to focus its objective on the aurora oval monitoring, having as secondary goal the obtention of in-situ measurements.

GMV has been awarded with one of the two parallel phase A studies of this re-oriented mission concept, having Qinetiq Space NV as subcontractor for platform-related aspects. The project started in July 2022.

The objective of the mission is the periodic imaging of the auroral regions, close to both geographic Poles, where the solar wind particles captured by the Earth Magnetic field interact with the atmosphere, producing the auroras. The acquired image should cover the complete Aurora Oval with cadence of observations shorter than 30 minutes for the operational mission.

Within this project, both demonstrator and final operational missions shall be designed, covering the orbit selection, the pointing strategy, the platform characteristics, the launcher opportunities, the concept of operations and the ground segment.

The payloads, Auroral Optical Spectral Imager (AOSI) and Aurora UV Imager (AUI), are out of the scope of this activity but their characteristics and interfaces shall be considered. The main challenges of the study are related to the need of performing the aurora observations from high altitudes (above 2500 km), to allow covering most of the aurora oval region in one image.

The implications of these high orbits in the launcher selection, in the protection of the equipment against high radiation dose, or in the need of propulsion system with high delta-V capabilities shall be carefully analysed. The project is scheduled to end in summer 2023.

GMV opens its doors in Romania to students from the ROSPIN Academy

GMV welcomed a group of students from the Summer School Program students of the ROSPIN (Romanian Space Initiative) Academy on August 30th at its facilities in Bucharest, Romania.

During the visit, the GMV team accompanied the students and showed them the company's technology solutions for the space projects that GMV is working on in Romania. They were taken on a tour of the Avionics Laboratory, where they were shown some of the hardware under development, such as HERA Image Processing Unit, SBSS-GNSS camera or the Space Rider SCOE (Special Check Out Equipment). The students have been captivated to learn how GMV is developing and testing the GNC system of HERA and JUVENTAS. The company presentation tour also took the students through an introduction to the state-of-the-art projects related to Autonomous Collision Avoidance, resilient PNT technologies, Optical Data Processing Tools and Electric Propulsion Orbit Raising optimization tools.

The visit is part of a study program in which GMV has also participated giving presentations, together with other companies from the space industry. As part of this program, students had to solve a practical case proposed and evaluated by the participating companies.

ROSPIN is a non-profit organization that works to promote the Romanian space ecosystem through a variety of activities and events, such as educational programs, projects and technical workshops aimed primary, secondary, and university-level students.

HERA takes its turn in the aftermath of DART

On September 27th, the USA's Double Asteroid Redirection Test (DART) probe successfully collided with its target, which was the moon of the Didymos binary asteroid system. Known as Dimorphos, this is an asteroid with a diameter of about 160 meters, giving it a size similar to that of the Great Pyramid of Giza. This asteroid orbits the system's main asteroid, known as Didymain, which has a diameter of about 780 meters.

NASA's DART is the first planetary defense mission, and its primary objective is to test the kinetic impactor concept. Afterwards, HERA, the European component in this coordinated planetary defense, will carry out a detailed study of the consequences of this impact.

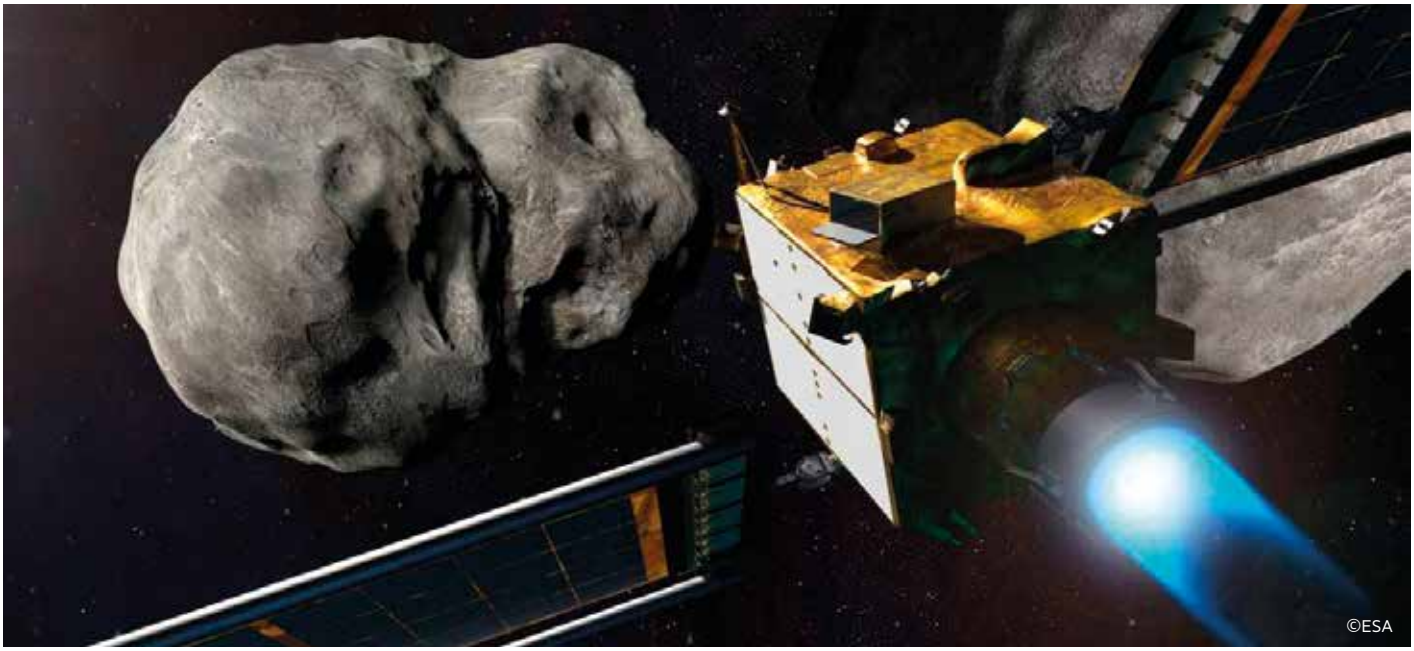
HERA will be launched from an Ariane 6 at the end of 2024, and it will arrive at the Didymos binary asteroid system in 2026. ESA is pursuing a twofold objective with HERA: to test key planetary defense technologies, such as autonomous navigation in proximity to a celestial body; and to perform a detailed study in order to characterize the binary system and its moon in particular, including detailed measurements focused on the results of the DART impact with Dimorphos. In this way, ESA will be further advancing the field of planetary defense by obtaining important scientific information, especially in relation to asteroid modeling. This is information that will also improve our understanding of the origins of our solar system and the origins of other planetary systems as well.

HERA will also have two CubeSats on board, known as JUVENTAS and MILANI. These will be carrying instruments to perform scientific experiments, which will produce additional data and other valuable information to complement the information being sent back to Earth by HERA.

GMV leads an international industry consortium with participants from Spain, Portugal, Romania, France, Germany, the Netherlands and Ireland. This group is responsible for mission analysis and for designing and developing HERA's guidance, navigation and control (GNC) system.

GMV has already developed an innovative autonomous GNC system, after taking into account the difficulties existing in relation to the approach and navigation operations. These include communication delays in deep space, the irregularities that characterize asteroids and the uncertainties associated with the unexplored deep space environment. There are two factors that characterize this special GNC system developed for HERA. It has the ability to autonomously execute the flight plan defined by the team at the ground control center and its degree of autonomy can then be increased, so that the maneuvers needed to fly to a particular altitude can be calculated on board, or so that an escape maneuver can be executed if a collision risk arises.

In addition, GMV's team in Romania has developed the mission analysis studies and GNC system for JUVENTAS. This is the nanosatellite responsible for measurements regarding Dimorphos' gravitational field and internal structure. There will also be experiments performed on satellite-to-satellite radioscience and a low-frequency radar study on the asteroid to reveal information about its interior. Finally, there will be a landing on Dimorphos, with measurement of the forces produced during touchdown.



GMV participates in the Global Symposium on Soils for Nutrition

The Global Symposium on Soils for Nutrition (GSOIL4N) was held from 26 to 29 July 2022 under the banner theme “Soils, where food begins”, taking stock of the current situation and soil fertility challenges in relation to crops, animal and human nutrition.

Questions dealt with included the regeneration of degraded soil, nutrient balance, agricultural output and Sustainable Development Goal 2, Zero Hunger. The symposium’s goal was to pinpoint critical knowledge gaps and provide the basis for discussion among policymakers and other stakeholders on the creation of solutions that can provide more nutritious food systems for enhanced human health and wellbeing while protecting the environment.

GMV participated in the session “Status and trends of global soil nutrient budget”, where it presented the ESA-funded “WorldSoils” project, seeking a preoperational system for soil organic carbon content on a worldwide scale, combining Earth Observation (EO) satellite data with big soil databases and modeling techniques. The presentation addressed the goals of GMV’s project, its various phases and stakeholders.

GMV is priming the WorldSoils consortium, comprising ISRIC - World Soil Information, DLR (German Aerospace Center), GFZ (German Research Center for Geosciences), UCL (Catholic University of Louvain), CZU (Czech University of Life Sciences), AUTh (Aristotle University of Thessaloniki) as partners and Tel Aviv University (TAU).

GMV offer for sea space monitoring focus on the UN Oceans Conference

The Ocean Conference promote by United Nations, which took place in Portugal from June 27th to July 1st, sought to alert, once again, to many of the deep-rooted problems of our societies that will require major structural transformations and shared solutions. To this end, it is important to find and mobilize innovative knowledge-based solutions aimed at starting a new chapter in global ocean action.

Solutions for a sustainably managed ocean involve green technology and innovative uses of marine resources. These also include addressing threats to the health, ecology, economy and management of the ocean – acidification, marine litter and pollution, illegal, unreported and unregulated fishing, and the loss of habitats and biodiversity.

GMV has been developing and participating in different projects in the monitoring of the oceans that responds exactly to these challenges. As is the case with the Plastic Less Society (PLESS), which uses satellite images to detect litter in the ocean and applies current and tidal models to predict the origin and end points of waste.

The Blue Economy project (ATIN-BLUECO), led by GMV and funded by the European Space Agency (ESA), proposes to develop and demonstrate Earth-Observation (EO) oriented data solutions that provide actionable information on marine litter and polluting spills, among other applications, for key coastal stakeholders. This project focuses on the geographical area of the Port of Vigo in Galicia (Spain), Azores (Portugal) and Argentina.

This two-year project is being implemented through the European Space Agency’s Atlantic Regional Initiative which aims to develop and implement data-driven EO solutions providing information to key coastal stakeholders. The applications developed will focus on coastal monitoring, ocean renewable energies and marine litter.

The ocean currently faces unprecedented threats. Technology and knowledge are an essential partner in finding answers for a better future.

Fireurisk, a fire-management paradigm switch

The fire season this year has been one of the worst this century. Flames devastated 660,000 hectares in Europe, the highest figures since records began. Spain is one of the hardest-hit countries together with Romania and Portugal. These daunting figures stress the need to look for efficient solutions and also underline the fact that solutions focusing on extinction rather than prevention can no longer cope with extreme fires.

The European Union, concerned about the current scenario and spurred on too by EFFIS's estimation that the risk of forest fires is likely to triple, decided to act, setting up in April last year the Horizon-2020 FirEUrisk project. FirEUrisk's main aim is to launch in Europe a scientific forest-fire prevention and response strategy. Portugal's Association for Development of Industrial Aerodynamics (*Asociación portuguesa para el Desarrollo de la Aerodinámica Industrial*: ADAI) is priming a multidisciplinary consortium of 38 institutions from 18 countries, with the technology multinational GMV to the fore.

The project aims at a paradigm switch in forest-fire management policies, looking for suitable products and services and building up knowledge to help tackle Europe's forest-fire challenges of today and those likely in the near future. FirEUrisk's main goal is to develop a scientific strategy to prepare ecosystems and society for the management of future fires, taking into account the crucial factors such as response capacity, operational experience, equipment, etc.

GMV is playing a key role in this international research project, coordinating two crucial tasks: evaluation of cascade effects (looking at both the causes and consequences of fires) and demonstration of proposals at a Europe-wide level and in five selected regions: the county of Kalmar (Sweden), Central Europe (Brandenburg and Saxony in Germany, Bohemia in the Czech Republic and Silesia in Poland), central Portugal, Barcelona (Spain) and Attica (Greece).

In all these regions a survey is being conducted up to October to compile regional needs, considering the different communities and fire risk. The idea is to pinpoint forest fire prevention needs and problems. The compiled information will show the scalability of the proposed developments: standardized fire indices, forecast models under climate-change conditions, evolution of scenarios in new areas affected by fire, technical training contents plus protocols for fire brigades and the reduction of fire risk for the population, among other factors.

GMV participates in Kenya's Space Expo & Conference 2022

In June The Kenya Space Agency hosted its inaugural Space Expo & Conference 2022 (KSEC2022) in Nairobi. For three days the conference held thematic chats, interactive sessions, discussion panels and presentation sessions by companies and clients for networking purposes.

KSEC2022 brought together several agencies, government representatives, politicians, leading academicians, representatives from space agencies, international organizations and young professionals in an interactive forum in which they could present current projects and breakthroughs and create links and collaboration arrangements in Africa's space system.

Invited by Kenya's Space Agency, GMV took part in KSEC2022 as coordinator of the H2020 AfriCultuReS Food Security project. AfriCultuReS was presented in the plenary session, explaining the work carried out under the project and the challenges posed and opportunities presented by the use of satellite data and agricultural surveillance to boost food security, an especially urgent topic in the current context of climate change. KSEC2022's project booth also served to bring AfriCultuReS and EO to wider notice.

GMV to Contribute Several Systems to Robotic Surface Vehicle Arm for Mars Sample Return Program

In July, the European Space Agency (ESA) and Leonardo S.P.A. gathered at the Farnborough International Airshow (FIA2022) for the signing ceremony of the Mars Sample Return-Sample Transfer Arm (MSR-STA) contract.

As part of this project, led at European level by Leonardo, GMV is set to develop various hardware and software subsystems. In fact, the company has already set about on the operational phases.

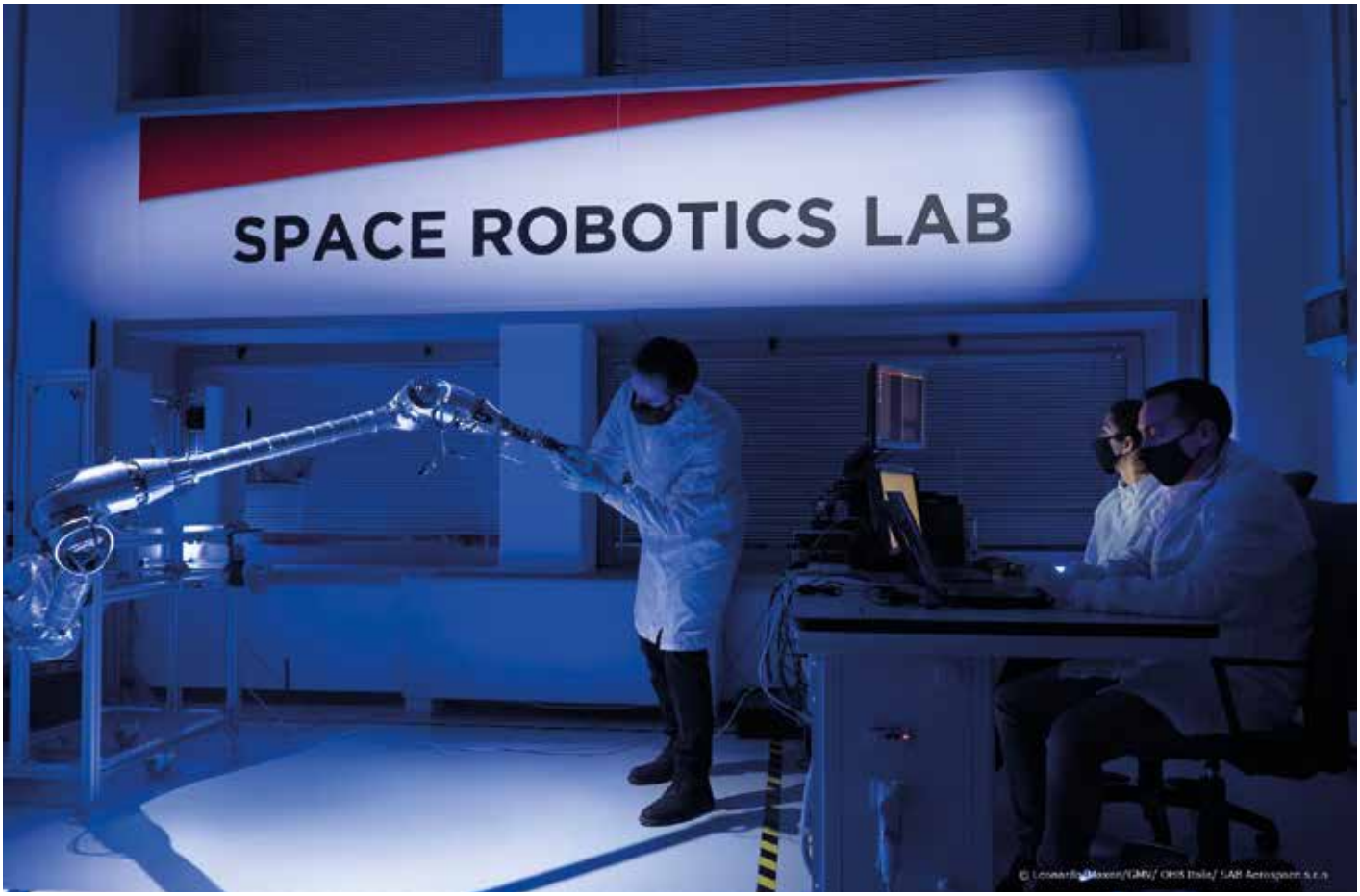
The STA is the European robotic arm being developed by ESA to transfer tubes containing Martian surface samples from the Perseverance rover to the container that will be returned to Earth, and to close said container. This robotic arm will travel to Mars aboard the Sample Return Lander developed by JPL in a joint ESA-NASA mission scheduled to take off in 2028.

In collaboration with 3DPlus and AVS, GMV will develop the STA's perception unit, consisting of cameras for detecting the sample tubes and other parts of the Sample Return Lander, as well as the caps that will protect these cameras during the Mars landing. This hardware, installed at the end of the robotic arm, will be exposed to the harsh conditions of Mars, with temperatures as low as -130°C.

GMV will also develop the high-level control software that will demonstrate the STA's compliance with mission requirements during its qualification in Europe. This software can visually detect the sample tubes and estimate their position so that they can be collected. The high-level software also controls the manipulator in such a way that the tubes can be retrieved and loaded into the container completely autonomously, without the involvement of ground control.

Finally, GMV will develop electrical ground support equipment (EGSEs) and a simulator to assist in systems engineering and STA operations on the surface of Mars.

The current phase will last one year, during which the preliminary design of these subsystems will be carried out. Delivery of the equipment will take place in 2025, with the flight phase then planned for 2028.



GMV Carries Out Cooperative Robotics Test Campaig

The tests, conducted under the CoRob-X space robotics project, set out to test and validate key technology for exploring zones of difficult access in a totally autonomous and independent way

A test campaign took place from 27 to 29 June at the Santa Bárbara Foundation's facilities in Ribera del Folgoso, León, Spain, as part of the Cooperative Robots for Extreme Environments (CoRob-X) space robotics project.

CoRob-X falls within the Strategic Research Cluster (SRC) on Space Robotics Technologies, coordinated by the PERASPERA project under the Horizon 2020 program.

Led by DFKI, CoRob-X aims to develop and demonstrate enabling technologies for multi-agent robotic equipment, geared towards improving cooperation between robots. The main application is lunar surface exploration, with a focus on hard-to-reach areas such as craters and lava tunnels.

CoRob-X will provide significant advances in future robotic exploration missions in critical areas such as locomotion, autonomy, and inter-robot cooperation.

One of the greatest challenges to improving planetary surface exploration is the development and demonstration of technologies and capabilities that planetary robots need to autonomously and independently make the necessary decisions to perform their tasks, minimize risk, and seize all the opportunities that come up to gather scientific information in hard-to-reach places.

In order to demonstrate the validity of these technologies for industry, the project is also developing a ground mining application. The ground-based project uses two GMV robots, a rover and a drone, that work together to explore a tunnel. The Santa Bárbara Foundation is collaborating with GMV on the project by providing its facilities.

The tests in June focused on the ground scenario and were carried out in tunnels at the Santa Bárbara Foundation's facilities. The aim of these tests was to demonstrate and validate key technologies for the exploration of this hard-to-reach area in a fully autonomous and independent manner. For this purpose, the Foxizirc rover, developed entirely by GMV, mapped the state of the tunnel during its route. Tests were also carried out with the drone to explore the tunnel in depth.

GMV strengthens its position among top EDF-participating companies in Europe

GMV has been awarded seven first-call European Defence Fund (EDF) projects, participating in a total of 19 European Defence Industrial Development Programme (EDIDP) and EDF projects

GMV has been awarded seven projects by the European Commission in the first call of the European Defence Fund (EDF).

The program aims to support the EU defense industry's equipment- and technology-development efforts by means of EU co-funding. The seven projects in which GMV is taking part from this call account for €347.6 million, around 29% of the total budget.

GMV's involvement once again targets strategic areas for the company. In fact, the value it brings to the table was crucial in clinching these deals, which in turn will improve the company's international standing with respect

to key technologies. The awarded projects will focus on developing missile defense system capabilities, systems for dismounted soldiers, avionics, command and control, navigation, and cyberdefense. In alphabetical order they are as follows:

- ACHILE (Augmented Capability for High End Soldiers): the goal of this project is to develop highly innovative solutions, demonstrating the benefits of GOSSRA-based open architecture, as well as breakthrough technologies that improve survivability, sustainability, mobility, lethality, and observation.

- ACTING (Advanced European Platform and Network of Cybersecurity Training and Exercises Centres): the project aims to integrate sophisticated methods and techniques for cyberattack simulation, expert performance analysis, and cybersecurity situational awareness scoring.

- EDOCC (European Defence Operational Collaborative Cloud): the project will create an online platform and develop a catalogue of services to increase the interoperability, efficiency, and resilience of military operations on the battlefield.

- EICACS (European Initiative for Collaborative Air Combat Standardisation): the project will focus on ensuring the interoperability of European air forces' combat air systems (with NATO and potentially with other coalitions) and the seamless integration of future air systems.

- EPIIC (Enhanced Pilot Interfaces & Interactions for Fighter): the project aims to tackle the enormous technological challenges of future air warfare and collaborative combat by identifying, evaluating, and developing highly innovative and disruptive technologies to be integrated into the future fighter aircraft.

- EU HYDEF (European Hypersonic Defence): this project will develop a European interceptor for potential threats by 2035. It will deliver the concept, risk mitigation, and demonstration of a cost-effective endo-atmospheric interceptor capable of operating at multiple levels.

- NAVGUARD (Advanced Galileo PRS Resilience for EU Defence): the project will develop ground and space systems to detect illegal activities on GNSS frequencies and geo-locate their sources. It will also build an information management subsystem together with a user interface to provide a situational awareness picture.

GMV's fine results in the past European Defence Industrial Development Programme (EDIDP) calls were key to the company being chosen again by the EDP, strengthening its hand even more in the EU's Preparatory Action on Defense Research (PADR) and building on its excellent results under the 2019 and 2020 EDIDP calls. Taking in this first EDF call and the two EDIDP calls, GMV has been awarded 19 projects in all, making it one of the leading European companies in terms of number of projects and the leader in the mid-cap category.

GMV involved in SENDA validation tests

GMV continues to make headway in the development and validation of the SENDA system under the contract signed between GMV and Navantia for supply and installation of five SENDA systems (including spare parts) in the future F-110 Frigates, scheduled for delivery to the Spanish navy by 2027.

This year the offshore patrol vessel known in Spanish as *Buque de Acción Marítima* (BAM) P-45 "Audaz" hosted a campaign of static in-port tests and dynamic open-sea tests on a set of algorithms developed under the SENDA system for the F-110 Frigates. The Naval Shipyard of Cartagena was the final destination at the end of 15 days.

The campaign has involved mainly obtaining data from a series of real sensors, such as Global Navigation Satellite System (GNSS) and inertial sensors fitted on a naval platform, developed in a working environment very similar to SENDA's future operational environment.

The detailed study of this information is now underway; this will not only validate the proper working and accuracy of SENDA's navigation data under real conditions but also confirm SENDA's interconnection with an onboard inertial unit, a situation tantamount to the one planned for F-110 Frigates.

GMV would like to thank the F-110 program office and diverse units of the Spanish navy for their collaboration in carrying out the recording campaign aboard the BAM "Audaz" (P-45). Special thanks go to the patrol vessel's crew and their commander for their active collaboration in these onboard tests, ensuring successful meeting of all targets set beforehand.

These recordings will be crucial for ongoing validation of the SENDA system, particularly when system performance has to be checked in any real navigation theater.

GMV takes part in the Military Exercise MILEX 22

GMV supported participation of the EU Command Control and Information System (EUCCIS) in the military exercise MILEX 22 with the aim of improving the EU's military response capacity to any crisis situation.

A Brussels Operational Headquarters (OHQ) participated in MILEX 22 under the responsibility of the Military Planning and Conduct Capability (MPCC), plus an ES Force HQ (FHQ) in Huesca.

MILEX 22 involved strategic-military planning of an executive operation based on an EU citizen evacuation scenario.

During the exercise preparation phase, carried out in May, GMV was responsible for setting up EUCCIS in the FHQ and its configuration in the OHQ.

This summer the exercise itself was carried out, with GMV providing users with EUCCIS training and also in situ support during the operation. This phase involved an interchange of diverse types of tactical items between OHQ and FHQ and representation of the situation on a Common Operational Picture (COP).

Crucially, this exercise has proven the MPCC's capacity to act as a general operational HQ and take on responsibility for strategic planning while holding an EU military operation.

The keenness to carry out exercises of this sort underlines the importance granted to giving Europe an ambitious and far-reaching peace- and security-keeping capacity within and beyond its own borders.

EUCCIS takes part in NATO's CWIX 2022 Interoperability Exercise

In June 2016 GMV signed a framework contract with the European External Action Service (EEAS) for maintenance and upgrading of the European Union Command & Control Information System (EUCCIS).

EEAS is now redefining and reinforcing its structures and capabilities to enable the EU to react more quickly, efficiently and effectively as a provider of security services outside its borders.

The European Union Command & Control Information System (EUCCIS) enables any operation commander to effectively plan, monitor and conduct EU-led crisis management operations in its ongoing quest for increasingly efficient collaboration between civilians and military personnel.

From 6 to 18 June EUCCIS took part in CWIX 2022 (Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise), NATO's biggest interoperability exercise held annually in Poland's Joint Forces Training Centre (NATO JFTC) in Bydgoszcz.

A GMV team took part in these exercises, with excellent results, proving EUCCIS interoperability with the command and control systems of the other participating countries, both by using Nato Vector Graphics (NVG) services and the Multilateral Interoperability Programme (MIP), as defined in the corresponding standards. Furthermore, EUCCIS's new tactical visor was used as consumer of geographical information products by other systems within the Functional Area of GEOMETOC (Geographical, Meteorological and Oceanographic data).

GMV's experience in command and control communication and information systems (CIS) stood it in good stead for taking on this range of activities, forging a long-term cooperation framework as a tried-and-trusted EEAS supplier.

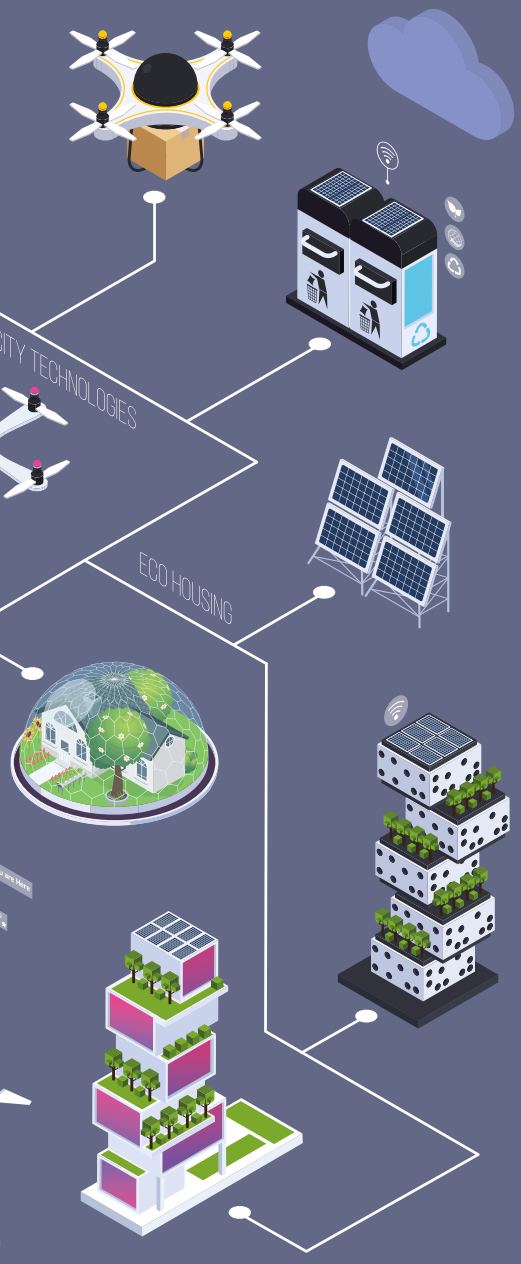
Opinion

Cyber-incidence response in a smart city

Digitalization represents a great chance to make our cities smarter. The downside is that it also opens up new attack vectors for cybercriminals. Right at the very start of any digitalization process, therefore, it is essential to take cybersecurity into account from the design up. After all, from a technological viewpoint, a smart city is made up and modeled by various components that are connected up to each other. These components, moreover, rely on a hardware infrastructure with software layers upon which the data handling services are hosted, to analyze and store this data and send it on to various communication channels. The sheer complexity of these solutions and the advent of new use cases in any connected city usher in various cyber-risk scenarios, calling for the setting up of new defense lines.

One of the main concerns of cybersecurity experts is to guarantee the integrity of the many smart-city sensors, few of which are ever set up securely or suitably tested. Another of the important

A smart city will have to make due risk-reduction arrangements while also assuring the attack response capability



points to be taken on board in any smart city is its attack surface. This varies directly with infrastructure complexity and system deployment, but is also affected by such factors as the existing interdependence between components and services, by citizen connectivity and the constant dataflow in the whole city modeling platform. Any device connected to a smart city's platform might therefore serve as an entry point for a large-scale attack.

Any technological solution should ideally incorporate cybersecurity measures such as suitable service access authentication, update automation (as far as this is possible), communications encryption and a monitoring system to flag up any security incidents. It should also cater for audits.

Cybersecurity experts play a crucial role here, flagging up weak points, suggesting suitable data encryption measures and establishing cybersecurity compliance levels, thereby cutting down the infrastructure risk level. This should take in the provision of essential

Patricia Tejado
Director of Public Digital Services
GMV´s Secure e-Solutions sector

city services. More than a nod should be given too to the wide-ranging data-security legislation.

Just as any big firm will run its own computer emergency response team (CERT), a smart city will have to make due risk-reduction arrangements while also assuring the attack response capability.

GMV attends Revolution Banking

GMV has taken part in the 8th Revolution Banking, Spain's marquee banking event, held last June. The company presented its range of ideas for helping its banking clients to offer today's new service models, geared towards the online consumer who demands mobility, flexibility, transparency and unbreachable security.

The finance sector is one of the main targets of cybercriminals. It is, after all, a critical, strictly-regulated and constantly developing sector that needs to protect its assets and guarantee its services with 100% confidence. GMV has now been working busily away for years to meet its needs, generating its own inhouse solutions like ***Checker ATM Security®***, a cybersecurity product custom designed for ATMs and e-kiosks. All these inhouse developments have won the firm a cast-iron reputation as a technology partner.

The Madrid stadium called Cívitas Metropolitano hosted 800 executives and experts from the banking technology sector. The conference's one hundred papers dealt with such burning issues as technology-driven banking innovation, how to achieve a sustainable and diverse banking future and the boom of digital currency.

GMV at the 1st National Congress for cybersecurity and the prevention of digital fraud

On 9 June Madrid hosted the first Congreso Nacional de Prevención del fraude digital y ciberseguridad (National Congress for cybersecurity and the prevention of digital fraud), organized by the World Compliance Association (WCA), with the support of Spain's National Cybersecurity Institute (*Instituto Nacional de Ciberseguridad:* INCIBE), CyberMadrid and Madrid city council.

GMV was invited to take part in the congress. Mariano J. Benito, GMV's cybersecurity, privacy and business continuity consultant, was a panelist in the round table "Maturity of Spain's cybersecurity business fabric: the importance of governance, international standards and self-regulation".

The guiding idea of this congress is to raise awareness of the importance of information-system cyberattack prevention models, while also stressing the need of establishing practical information security measures.

WCA centers on the promotion, recognition and assessment of organizations' compliance activities (regardless of the organization's legal form) plus the development of tools and processes to ensure proper protection against certain offences/ infractions perpetrated by their employees, collaborators or any other person related to them in any way.

GMV at Hannover Messe

The world's biggest industrial tradefair, Hannover Messe, held last June, brought together various GMV representatives from different offices, led by the company president, Mónica Martínez. Assembled at the company's stand, GMV's professionals were ever ready to explain GMV's ideas for building a sustainable, resilient, cybersecure and person-centered Industry-5.0. Pride of place here goes to the stand visit by the Ambassador of Spain in Germany, Ricardo Martínez Vázquez, and members of the embassy team, all of whom showed a keen interest in GMV's marquee industry-5.0 projects.

In early 2021 the term "industry 5.0" was coined by the European Commission with the idea of focusing sector-development efforts on a technology-intensive production model in order to become more competitive and ensure a positive knock-on effect throughout society. Sustainability, human-centeredness and resilience have become the three main pillars of the new industry, already featured and dealt with in the last Hannover Messe. This year's fair also continued to stress industry-5.0's paradigm shift in the sector.

Hannover Messe congregated about 2500 firms to showcase their factory technology and energy systems of the future in the exhibition center. Under the banner theme "Industrial Transformation", the participating firms showed how connected production facilities could be run more efficiently and save resources. They also showed how to generate and transmit energy in a sustainable way.

Fundación Borredá invites GMV to speak about quantum technology and cryptography

Under the title "The Zoom of Fundación Borredá" a digital discussion panel was held last August with GMV as guest to speak about quantum technology and cryptography.

Víctor Gaspar, Business Partner of GMV's Secure e-Solutions sector and coordinator of the CUCO project, together with Enrique Crespo, Business Partner of GMV's Secure e-Solutions sector and cryptography specialist of the Galileo project, took part in the discussion, talking about such issues as the two types of cryptography that might in the future be applied to the key distribution problem: one related to quantum key distribution, which attempts to apply certain quantum physics principles for its protection; and the other bound up with postquantum cryptography.

As for the advent of quantum computers, Gaspar argued that the ones beginning to appear now still have cryptography-breaking limitations; they are not yet powerful enough. Meanwhile we need to gird our loins for swingeing changes in cryptography, soon to be upon us.

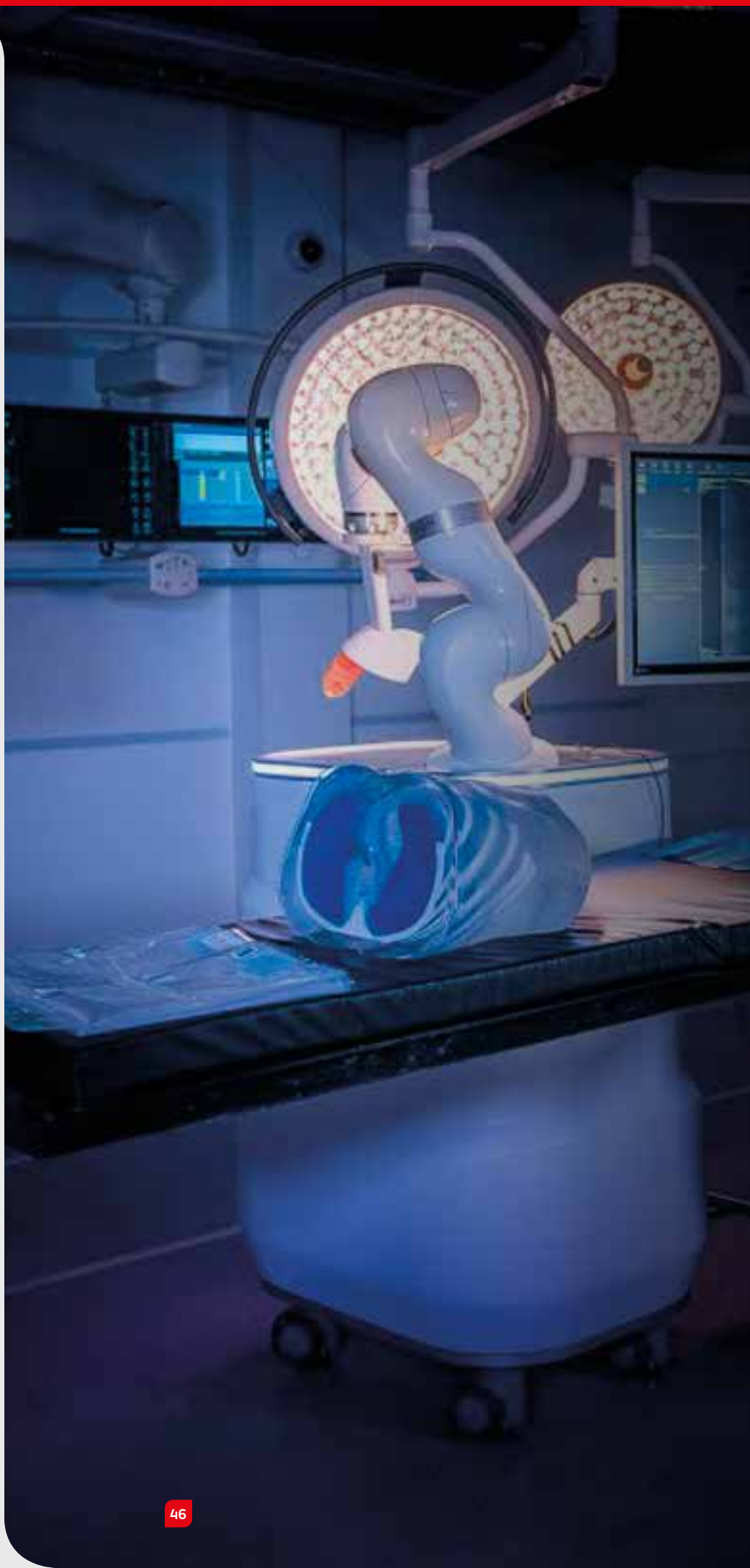
GMV participates in a summer course under the title “Towards an open and accessible healthcare system”

Last June GMV took part in the summer course “Digital healthcare. Challenges and opportunities”, organized by Malaga’s Fundación General Universidad and Malaga TechPark, an organization with which GMV is collaborating under the Malaga4DigitalHealth initiative. Carlos Royo, GMV’s Digital Healthcare Strategy Director, gave a paper on the healthcare revolution that is likely to arise from data mining.

Carlos Royo’s paper argued that, at this juncture, “we preen ourselves on digital advances when healthcare cannot be anything else than digital. What patients now expect from physicians is that they cure them as soon as possible and wherever they may be, without taking on board the fact that, in most sectors, the service is already digital”. GMV’s Digital Healthcare Strategy Director added that companies must now come up with top-quality solutions and make patients feel well looked after.

Royo also addressed the need for collaboration and involvement of clinicians in encouraging successful projects geared towards personalized and precision medicine. He cited as example the initiative driven by Málaga TechPark in collaboration with the Hospital Regional de Málaga and universities and companies of the sector (including GMV): Malaga4DigitalHealth.

The discussion panel moderated by Manuel Enciso, director of the IT engineering school of Universidad de Málaga “Towards an open and accessible healthcare system”, with the participation of Royo, dealt with such burning issues as whether or not technology is dehumanized, data processing ethics, the one health concept, the data donor and data governance.



M²OLIE extends its research for another 10 years in search of new remedies for oligometastatic cancer

This 28-company research project thus gets a new lease of life. These member companies include GMV, which, for 10 years now, has been encouraging collaboration between clinical research, on the one hand, and technology and industry, on the other

There is certainly room for improvement in today's treatment of patients with oligometastatic tumors, currently the cause of the greatest number of cancer deaths.

Although a primary tumor can normally be addressed with good results, the secondary usually involves from one to five metastatic lesions in the liver and brain, which are the main cause of death in some patients. There is therefore no little justification for the 10-year extension of this research project, kick started 10 years ago now by the German research campus M²OLIE (Mannheim Molecular Intervention Environment) in an attempt to improve the treatment of oligometastatic tumors by dint of precision medicine and robotics. GMV is the only Spanish firm among the 28 project members.

Under current procedures most metastatic cancer sufferers receive systemic treatment only when the molecular characteristics of the metastasis can be differentiated from each other and even from the primary tumor. M²OLIE advocates a different approach, with specific therapeutic targets for each tumor. This involves the development of groundbreaking diagnostic methods based on precise images and molecular analysis, plus robotic assistance in carrying out biopsies and operations.

Carlos Illana, product head of GMV's Secure e-solutions sector, explains that intraoperative radiotherapy caters for the combined treatment of surgical resection and radiotherapy. This restrains tumor proliferation until the adjuvant treatment kicks in, and helps to preserve the organs at risk. Another boon is that in-hospital treatment time is reduced and the patients' risk of infection is therefore lower.

Within the field of radiosurgical planning, therefore, GMV is now working on technology that allows for administration of large intraoperative doses with high precision and safety. GMV's contribution to tumor resection and dose administration comes within the field of surgical and radiotherapy navigation and planning. In the words of Illana himself, "navigation and simulation, applied in intraoperative procedures, boost surgical and radiotherapy accuracy".

The personalized medicine project based on big data, Cuidat-e, is rolled out with GMV technology

The big-data personalized medicine project (MedP-Big Data) "Cuidat-e", drawing on GMV technology, has kicked off with a first pick-up phase in the Canary Islands and Valencia. Led by the Canary Island Health Service and carried out jointly with Valencia's regional universal and public health ministry, Cuidat-e aims to improve personalized healthcare on the strength of ICTs like "mHealth", the internet of things, big data/smart data, artificial intelligence, etc. It also hopes to contribute towards system sustainability by boosting efficiency.

People from the abovementioned Spanish regions, taking part in this project for five months, will have their health and welfare monitored with IT applications centered on the matters under study in the project: food, physical exercise, mood, addictions and loneliness.

GMV's idea for developing Cuidat-e is an integrating solution with collaborative data access, seeking to cull the greatest possible amount of quality information and health evidence by using artificial intelligence (AI). It also sets out to enhance access, efficiency and quality of the clinical and business processes used by organizations and healthcare professionals, patients and relatives.

Inmaculada Pérez Garro, GMV's Digital Health manager, explains that the solutions for supporting clinical decision-making cannot be conceived as standalone systems. Hence inclusion of the task of humanizing artificial intelligence and the pickup of user experiences, enabling an evaluation to be made of the social and psychological impact these new services might have on the social healthcare fabric. She goes on: "proposed use cases are designed to be integrated transparently and completely adapted in the clinician's daily procedures and workflow, thus favoring usability".

Cuidat-e is co-financed by the Spanish Ministry of Science and Innovation and by ERDF funds, forming part of a strategy for digital healthcare transformation in the interests of speeding up research and setting up evidence-based healthcare on the strength of a personalized and patient-centered medicine.

Insights extracted from healthcare data favor system sustainability

Proper mining of healthcare data, offering top-quality services, is conducive to system sustainability. Analysis of this data helps to boost efficiency while also favoring earlier diagnosis, personalized treatment and shorter waiting lists. It even allows us to ascertain the level of specialization in the treatment of a given illness in one or other hospital and their average waiting-list time, making health services more competitive.

It also gives information for traceability of processes and pinpointing of any necessary changes. In the words of Inmaculada Pérez Garro, GMV's Digital Healthcare manager, data analysis is allowing us to ascertain why the process might have degraded and whether any changes are needed. She also argues that data inevitably leads to action and, at healthcare level, this new situation is tied in with a cultural change. Thus, in R&D projects there is a humanization package for adapting the technology to the new process.

This cultural change is also necessary in the data-exchange and -assignment process, where there is an understandable resistance due to the legislative restraints this data is subject to, healthcare data above all. Another important factor is the huge volume of data needed for training up the algorithms.

To speed up research GMV has been driving the "TARTAGLIA" project, which sets out to create a data network that enables algorithms to be trained up in a federated manner, avoiding any data sharing and speeding up the application of artificial intelligence to healthcare systems. GMV's Digital Healthcare manager also argued that "guaranteeing privacy and security, and data standardization are time-consuming tasks that make the research process longer". All this was discussed in the R&D week of Valencia Region, held last July.

The Hospital Puerta de Hierro takes up GMV's natural language technology to improve the treatment of kidney cancer

The information gleaned from the diagnostic procedures applied during the study phase, its development over the years and the patients' lifestyles have all been highly valuable for the clinicians

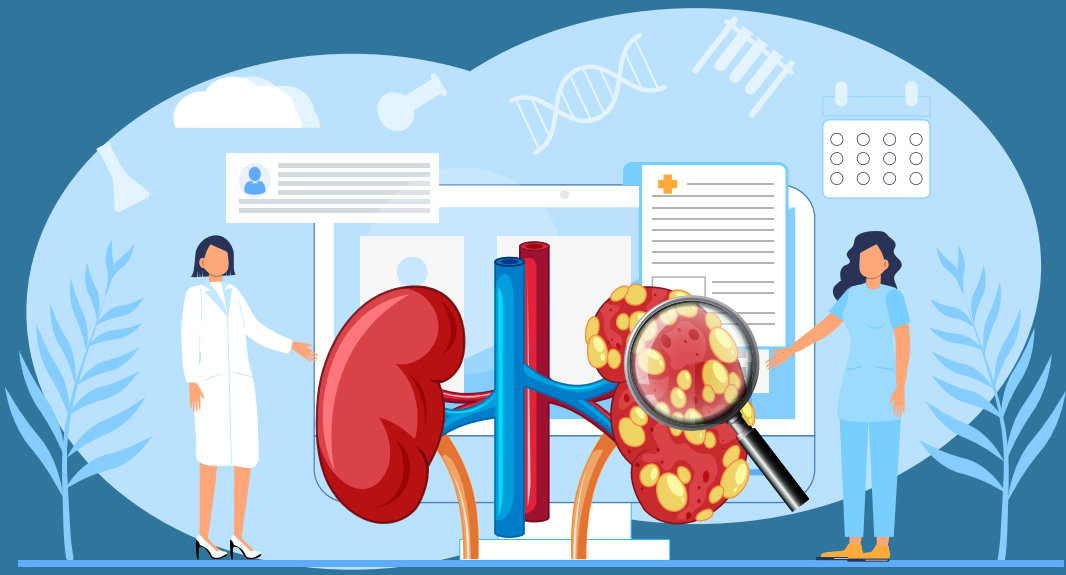
The urology service of Madrid's Hospital Universitario Puerta de Hierro, using GMV technology and with the medical advice of the consultant Azierta, has analyzed the clinical information of a wide-ranging group of patients, culled over a ten-year period. The overall idea in this endeavor is to improve our evidence-based knowledge of the behavior of renal cell carcinomas and find out more about the pathology, with the ultimate aim of improving treatment by way of personalized medicine.

The information gleaned from the diagnostic procedures applied during the study phase, its development over the years (trying out different therapies on the basis of the comorbidities described by patients) and the patients' lifestyles have all been highly valuable for the clinicians. Doctor Joaquín Carballido Rodríguez, head of the urology service of Madrid's Hospital Universitario Puerta de Hierro, has played a crucial part in ensuring success of this research.

Renal cell carcinoma is the commonest type of kidney cancer, accounting for over 90% of malign kidney tumors. Renal malignancies, notably, show a high morphological diversity, with a different biological behavior in each one of them. For that very reason, the information obtained from this research into patients' prognosis is crucial for deciding on the best treatment strategy in each particular case and also for giving future treatment and developing specific follow-up schemes.

The application of technology has therefore enabled clinicians to structure textual healthcare data (notes, forms and patients' clinical history reports) in order to obtain valuable information on the evolution of treatment over the years, confirming the suspicion of clinicians over the popularity or suitability of certain drugs and enabling them to identify the best performing treatment to improve patients' quality of life. The aggregation of information also means statistic techniques can be used to analyze survival rates, the difference between various treatments, suitability for different age groups, gender, etc.

In the words of Inmaculada Pérez Garro, GMV's Digital Health Manager, in order to extract insights from this data, an ontology of renal cell carcinoma has been drawn up fielding all concepts of interest (reusable for new datasets from the same clinical field) and the texts have been processed by means of GMV's inhouse natural language processing tool, ***uQuery***®.



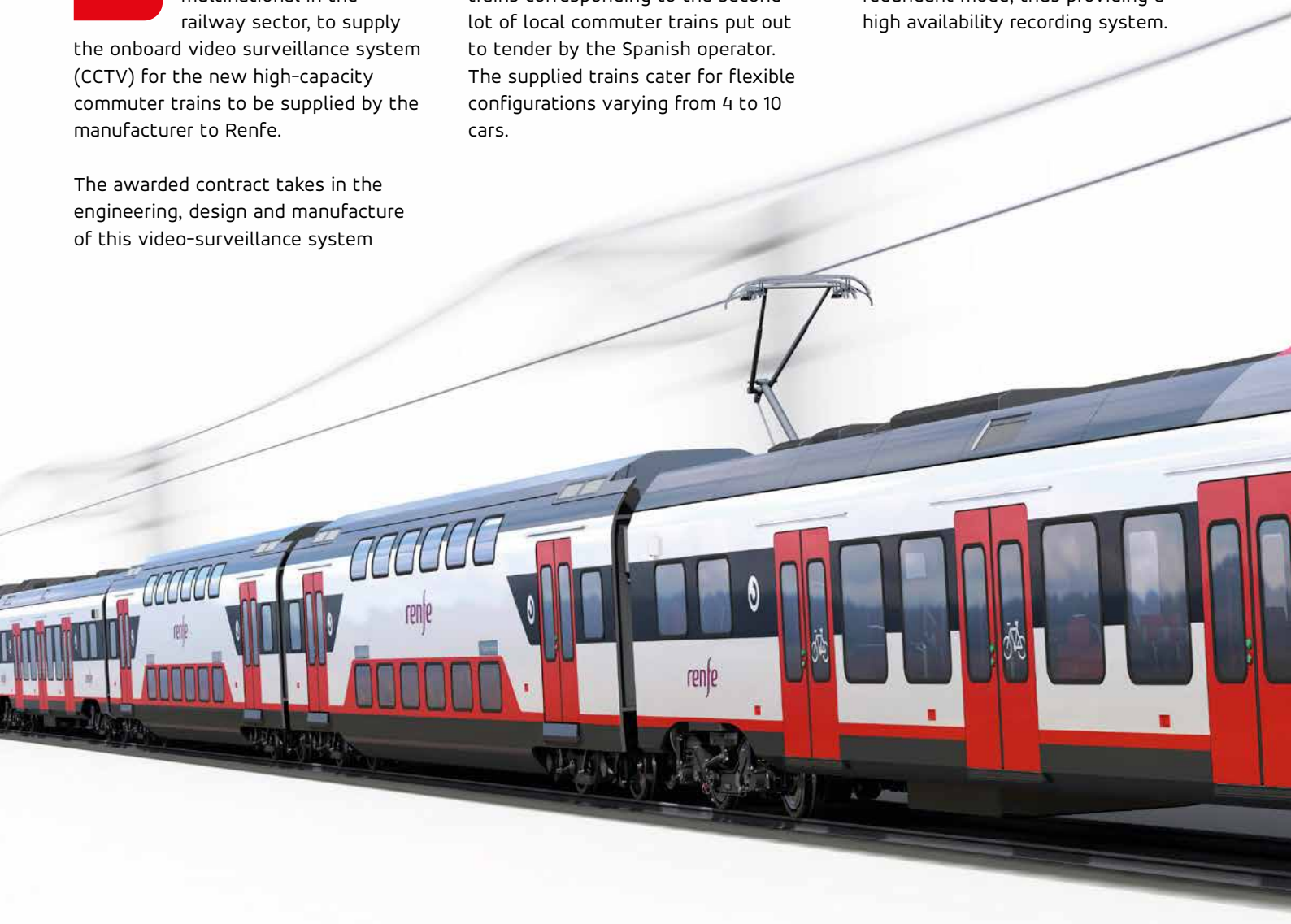
GMV supplies Stadler's new trains with their onboard video-surveillance system

The awarded contract comprises the engineering, design and manufacture of the video-surveillance system (CCTV) for the trains that the manufacturer will supply to Renfe

GMV has been selected by Stadler, a leading multinational in the railway sector, to supply the onboard video surveillance system (CCTV) for the new high-capacity commuter trains to be supplied by the manufacturer to Renfe.

The awarded contract takes in the engineering, design and manufacture of this video-surveillance system (CCTV) to be fitted by Stadler in the 59 new high-capacity commuter trains corresponding to the second lot of local commuter trains put out to tender by the Spanish operator. The supplied trains cater for flexible configurations varying from 4 to 10 cars.

Each train will be fitted with one onboard recorder per car, working in redundant mode, thus providing a high availability recording system.



The video-surveillance system also includes inside cameras, front-mounted cameras (providing frequencies of up to 60 images per second) and rear-view cameras with a built-in heating system.

This recording system is topped up in each car with a shockproof memory (also called “video black box”); this safeguards the recorded images in the event of any accident or incident. The same system will be used for recording driver cab audio; this will come in useful in the event of accidents, intrusion or any other incidents.

This video-surveillance system is also fitted with train-to-ground communications to cater for both real time display and remote downloading of all onboard images from the control center.

Co-supplied with this system will be an exit signal warning system to boost safety for trains running on lines with conventional signaling in the event of station exits, with an additional control condition to minimize the likelihood of human failure. The system is made up by an onboard smart unit that implements the required logic plus a simple human-machine interface for drivers, comprising several push buttons. The onboard unit will immobilize the train, preventing it from starting up in the moment of station exit until a certain logical constraint has been met, ensuring that the driver has checked the state of the luminous exit signal. This same system also records in real time each one of the events making up this process; this can subsequently be downloaded and analyzed by RENFE by means of a software tool specially designed for that purpose.

TMB awards GMV the contract for the new tourism bus access system

Transports Metopolitans de Barcelona (TMB) has recently awarded GMV the contract for supplying by 2023 an onboard validator system for the 75 buses running on the "Barcelona Tourism Bus" service, allowing passengers to board the bus quickly and conveniently.

As well as affording easy access, the main purposes of this contract are:

- Enhance the data quality of ridership per hours and sites of interest.
- Boost passenger and crew health protection against COVID-19, reducing points of contact.
- Cut down the validation time.

In pursuit of these goals the buses will be fitted with a state-of-the-art onboard validator, allowing passengers to validate their travel entitlement both as paper tickets and on their cell phones. This equipment will be connected up to TMB's central system, using the bus's existing onboard network.

Travel entitlements will be read optically by means of QR codes, although the equipment supplied by GMV is also enabled for reading contactless NFC cards and EMV bankcards. This means that new farecards or bankcards can be phased in in the future as need be, using the same hardware.

The validator can be monitored from the control center, which can also take on parametrization- and management-tasks to suit TMB's particular needs. GMV, supplier of a whole host of technological solutions for TMB, will enable these new validators to be integrated with diverse systems, both at control-center and onboard level, by way of the following services:

- Connection with configuration management systems, including topology nd operation parametrization information.
- Integration with remote control applications to cater for real-time validator monitoring or change of configuration by modifying operational parameters or file downloading.
- Validator integration into the bus's onboard network, obtaining service, geopositioning and scheduling information.

This new award cements GMV's business in Barcelona and confirms its status as one of TMB's go-to suppliers; TMB itself is one of the flagship ITS operators.

GMV to supply the new ITSs for Terrasa's urban bus fleet

Under this new Avanza project GMV will be renewing several previously supplied systems for which it has held maintenance responsibilities to date

GMV Avanza turns again to GMV for the supply of its fleet management system, passenger information system, onboard video-surveillance system (CCTV) and eco-driving system for the urban bus fleet of Terrasa (Barcelona).

Under this new Avanza project GMV will be renewing several previously supplied systems for which it has held maintenance responsibilities to date.

TMESA (Transports Municipals D'Egara), with an 80% stake held by Avanza and 20% by the City Council of Terrasa, is the firm that runs the public urban transport service of the city of Terrasa. TMESA has now awarded GMV a contract for supplying a fleet management system, passenger information system, onboard video-surveillance system (CCTV) and eco-driving system for its 70-bus fleet running on Terrasa's public urban transport system.

Under this contract GMV will be fitting Avanza's buses with onboard fleet-management, passenger-information and ecoDriving equipment, which will double up as videorecorder of the CCTV system, comprising 3 IP cameras per bus.

The onboard passenger information system will show passengers information on a TFT panel. The ecoDriving system's FMS-CANBUS interface will compile technical data and alarms, performance measurements with real time KPI feedback to drivers through the ecoDisplay monitor. It will also generate automatic alerts for the maintenance team for a proactive service. This data will be used for assessing performance in terms of comfort and ecodriving.

The project also takes in integration with Terrasa Council's «Sentilo» platform and implementation of an external system based on SIRI standards and static GTFS.

Lastly, GMV will be supplying the control center's backoffice fleet-management, ecoDriving and CCTV systems, to run all onboard ITS equipment.

GMV wins the contract for supplying Szczecin's new ticketing machines and panels

The contractor priming renewal of Szczecin's tramline system has awarded GMV a public contract for the supply of six ticket vending machines and 15 tram-stop panels of the dynamic passenger information system.

The supplied equipment will be fitted in Szczecin's central public transport management system, brought on stream in 2015. The ticket vending machines will be fitted with 15-inch touch screens, supplying single-journey and season tickets according to the fare tariffs established by Szczecin's Road and Public Transport Authority (Zarząd Dróg i Transportu Miejskiego w Szczecinie: ZDiTM).

The vending machines cater for cash payments, EMV chip cards and contactless cards, as well as the Szczecin Agglomeration Card (SKA), which enables users to build up travel entitlements in an electronic wallet and travel in Check-in/Check-out mode. The machines will also be fitted with a SKA card vending tag-on. Passengers will thus be able to buy SKA cards directly in the vending machines and include the particular transport entitlement they have bought. High-luminosity tram-stop LED panels display ETAs, as gleaned from GMV's main fleet management system.

After this installation Szczecin will be working with 135 passenger information panels and 42 ticket vending machines within the urban space. As well as the abovementioned tram-stop infrastructure, the integrated system will include diverse devices onboard buses and trams, such as industrial M20 computers, cameras and video recorders for ***REC30*** surveillance systems, ***CTC-910*** validators, mobile TRB ticket vending machines and multimedia passenger information screens.

The purchaser, in collaboration with GMV, has taken on responsibility for carrying out the extensions and maintenance of the complete system since 2015.

Renewal of the Malta Public Transport contract

In July GMV renewed the maintenance contract of Malta Public Transport (MPT), taking in a fleet management system, video-surveillance system and electronic fare collection system for a 415-bus fleet.

An important new feature in this renewal is extension of the contract to include maintenance of GMV's new ABT system, fitted in the fleet throughout 2021.

Under the account-based ticketing (ABT) system the passenger's ticket information is stored in the system's backoffice. ABT differs from traditional card-based systems because business norms and fare calculations are handled in the backoffice.

The fare is calculated and billed at the end of journey, with nothing being recorded on the card itself. This means that the system entrance and exit token is nothing more than a unique client identifier, linked in to his or her account.

Service maintenance, as in previous contract renewals, is based on remote support to clear up any software incidents in the control centers' applications and the firmware in the onboard equipment of the fleet-management-CCTV system and ticketing equipment. It also takes in third-level maintenance, i.e., repair of onboard hardware supplied by the company.

GMV to supply the extension of the fleet management system for the public transport of Castelo Branco

The public transport authority of Castelo Branco (Portugal) turns to GMV for extension of its fleet management system, supplied by GMV back in 2019.

The City Council of Castelo Branco has awarded GMV the contract for extension of the fleet management system previously supplied by the company for local public urban transport. This involves fitting out 22 additional buses plus renewal and upgrading of the 8 fleet management systems fitted under the initial contract.

This extension is a follow-on from the original fleet-management contract back in 2019, which took in the fitting of fleet management equipment for 8 buses, the setting up of a website and a mobile passenger information app plus the supply of 4 bus-stop information TFT panels.

At control-center level, GMV supplied its fleet-management backoffice and content manager of the bus-stop panels. Furthermore, in 2021, GMV won another extension contract, consisting of the supply of 14 bus-stop information TFT panels and 2 large-scale screens for the control center.

This new project with Castelo Branco establishes GMV firmly as one of the municipality's tried-and-tested suppliers for local urban public transport.

GMV supplies onboard technology for Cyprus's new buses

The company Osea has been awarded by the Ministry of Transport, Communications and Public Works of the Republic of Cyprus with the bus transport concession of the city of Famagusta (Cyprus) taking in too the routes from the province of Famagusta to Larnaca and from Larnaca to Famagusta.

Osea has turned to GMV as main onboard technology supplier for the new buses to run on the abovementioned concessions. GMV thus reinforces its position as one of Cyprus's main ITS suppliers.

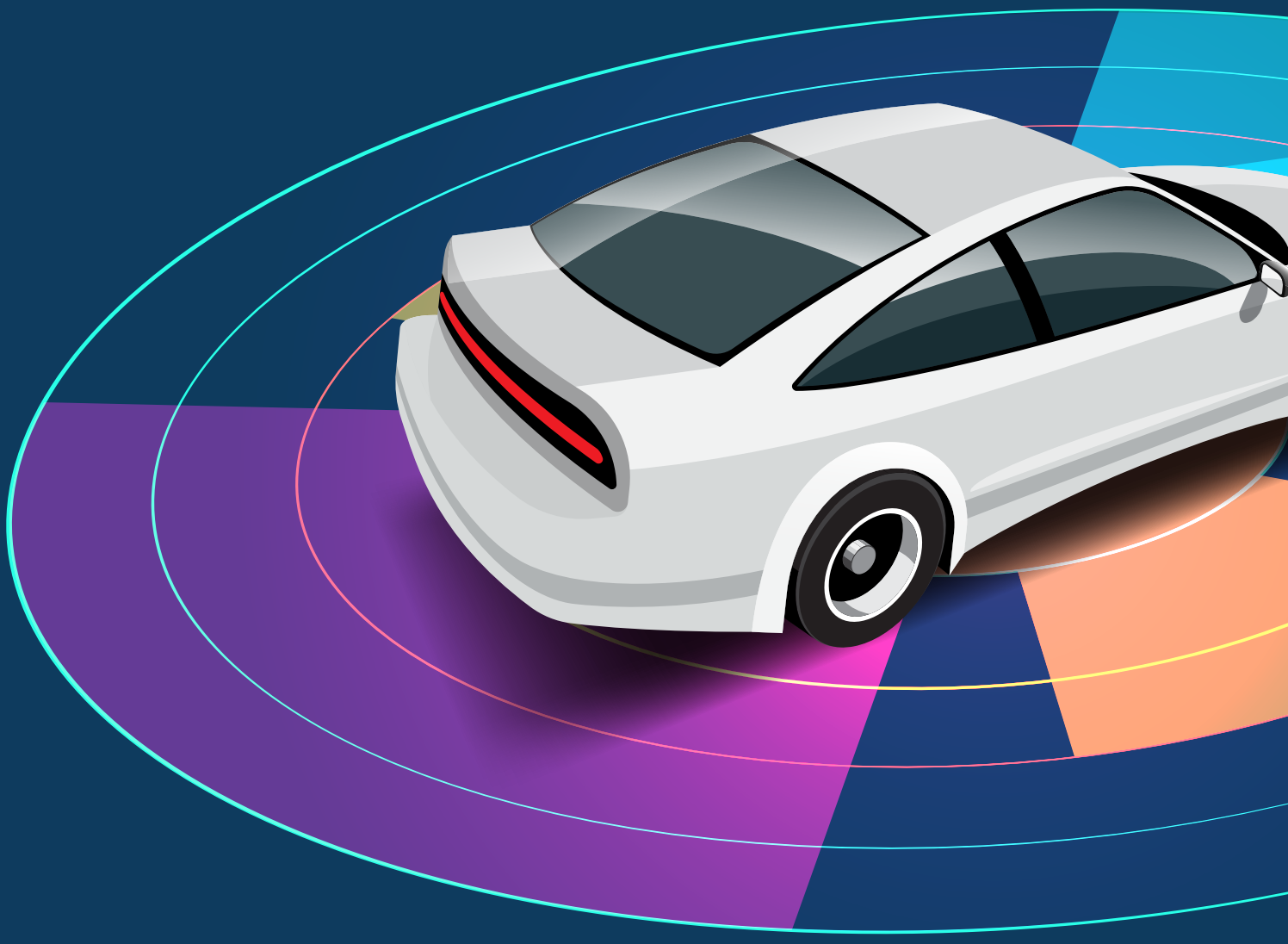
Osea has asked GMV to phase an onboard video-surveillance system into all the 60 buses to be run on the concession routes. These buses will thus be fitted with an onboard video recorder and 3 IP cameras. This high-resolution video recorder caters for onboard storing of images on a hard disc especially designed to withstand the shocks of a vehicle in movement.

A passenger-information will supply passengers with real time information on the upcoming stops, points of interest, publicity videos, information campaigns or events associated with specific zones or stops, among other items.

Finally, a two-way ridership counting system will also be fitted on all doors of a select number of buses. Osea will therefore now have access to precise demand data; jointly with the Ministry of Transport, Communications and Public Works, it will therefore now be able to bring its range of services firmly into line with passenger needs, modifying lines and schedules according to the data obtained.

GMV at the cutting edge of developing technologies for future autonomous and connected vehicles

Under the National Recovery, Transformation and Resilience Plan and brokered by EU Next Generation funds, R3CAV has now kicked off, to contribute towards the development of important automotive technology



After a pandemic-hit kickoff, the partners of the R3CAV project (Robust, Reliable and Resilient Connected and Automated Vehicle for people transport) recently held its first onsite working meeting in the Renault Group R&D Center in Valladolid.

R3CAV's main remit is to develop new connected technology and design a new adaptable software and hardware architecture for future autonomous connected vehicles. This architecture is capable of working at various autonomy levels, ranging from advanced driver assistance systems with predictive controls to completely autonomous, driverless systems.

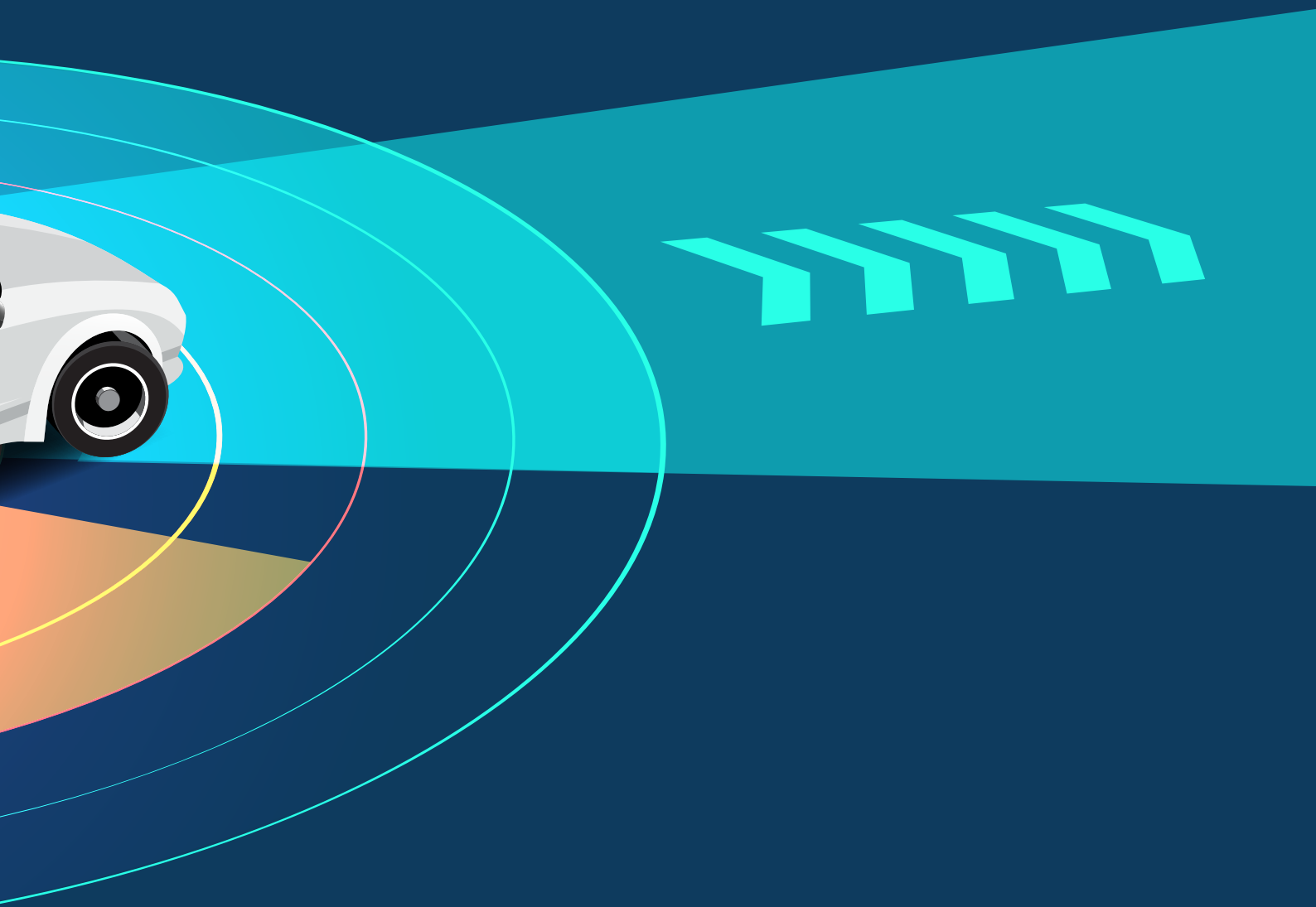
R3CAV, financed by Next Generation EU funds, falls under the umbrella of the National Recovery, Transformation and Resilience Plan. It aims to speed up the recovery of the automotive sector by reinforcing its innovative capacity while also taking on the challenges of sustainable mobility and zero emissions.

GMV is part of the project consortium together with Spanish firms like Renault Group, Alsa, Indra, Sigma, MásMóvil and Masermic. Other participants include national research organizations, all under the leadership of Renault Group.

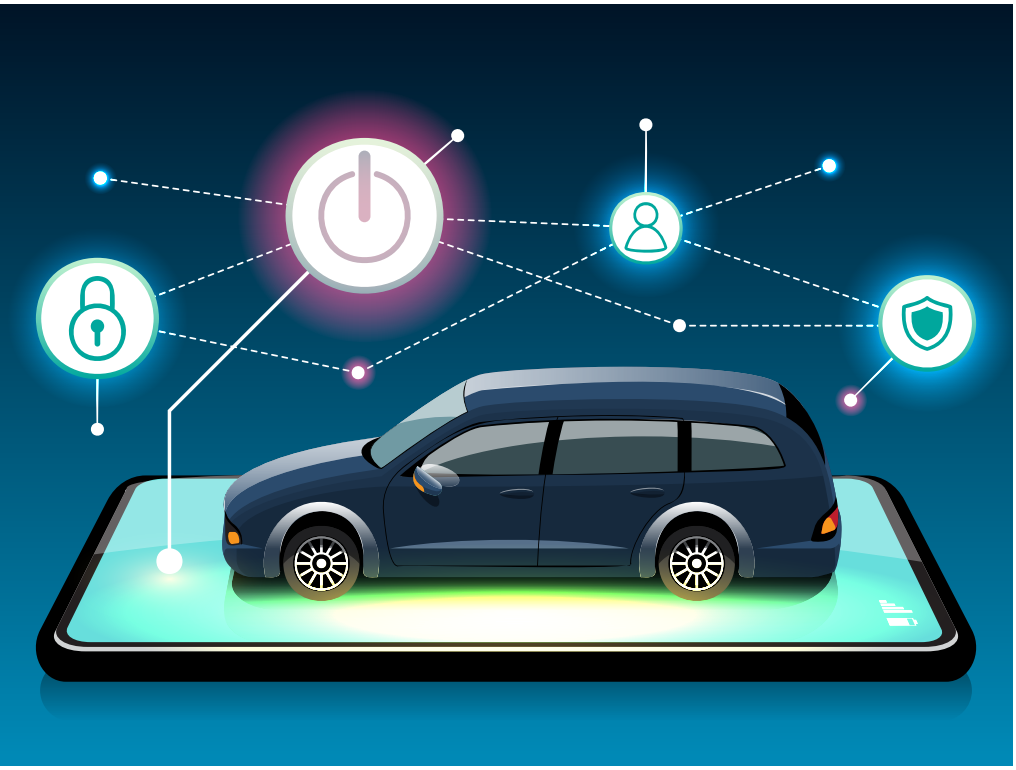
GMV, in particular, is working in three separate fields: firstly, optimization of absolute GNSS-based positioning systems, both in autonomous and cooperative systems; secondly, research into roadside-infrastructure-connected services, culminating in the development of a smart V2X-based speed-control module and, thirdly, Cooperative Intelligent Transport Systems (C-ITS) and vehicle cybersecurity, involving the design and development of a vehicle-protecting, intrusion-detection system based on IDPS, plus security hardening of V2X communications.

Validation of these three developed technologies is based on dry runs in two specific use cases. The first is an open environment in Alcobendas, where the solutions will be put through their paces in Level L2 connected vehicles, in the first place and then in an L2-L3 people-transporting platform. The second is a controlled environment on Renault's site in Villamuriel de Cerrato (Palencia), where an L4 autonomy vehicle will run on a known trajectory with 24/7 availability under any weather conditions.

R3CAV, scheduled to last until late 2023, enjoys a huge institutional support and will generate 19 new jobs.



GMV to takes part in ASEPA-INSIA's 6th Specialist Autonomous and Connected Vehicle Course



After the warm welcome given to the previous five "Specialist Autonomous and Connected Vehicle Courses", and taking its cue from the smooth operation of the online format of the 5th course, ASEPA has now launched the 6th course of its kind in collaboration with the University Automotive Research Institute (INSIA-UPM in Spanish initials).

The course is divided into two modules, one dealing with the autonomous vehicle and the other with the connected vehicle, tapping into the advantages of the online modality to open up attendance to automotive professionals and colleagues both from Spain and Iberoamerica.

Running from 17 October to 30 November, the course will be given by 13 experts in these specialties of the future, including researchers and academicians plus representatives from the firms that are now spearheading the development of autonomous and connected vehicles.

As in previous courses GMV will be giving one of the sessions, presenting various use cases of vehicle-communication applications and fleshing out the wide range of connected-vehicles services that GMV now brings its wealth of experience to.

Preparations begin for AUTOSAR's 20th anniversary

AUTOSAR (Automotive Open System Architecture) is an association of various carmakers, suppliers of automotive services, electronics, semiconductors and software at world level. Since its creation back in 2003 its target has been the streamlining of systems with the aim of achieving multivendor modules that are easily integratable into various platforms. With this aim in mind AUTOSAR brings together the top OEMs, suppliers and other automotive firms to work away on the definition, development and upgrading of a standard architecture open to the whole automotive world.

Since 2003 AUTOSAR has furnished four main versions of its standardized software architecture for its Classic Platform plus a version for acceptance testing. In 2013 AUTOSAR's consortium entered a continuous working mode for Classic Platform to keep up the standard and provide selected improvements.

In 2016 work began on the Adaptive Platform; the first version was published in early 2017, followed by two subsequent versions up to March 2018. Thanks to this standardization service- and application-development firms like GMV can now dedicate their effort to the development of new functions, boosting product maturity and ensuring required automotive quality standards, saving unnecessary effort of integrating the same solution on different platforms.

GMV decided to become an associate partner of AUTOSAR in 2018; since then it has been used in various projects and products as the secure and accurate positioning solution to be rolled out in upcoming autonomous vehicles.

AUTOSAR continues to grow. Together with its partners it is now preparing for the coming year and its 20th anniversary. GMV is delighted to be part of AUTOSAR and help the association to celebrate its anniversary.

Galileo Green Lanes goes live with GMV solution

On September the platform developed by GMV for the Galileo Green Lanes Project of the European Union Agency for the Space Programme (EUSPA) will officially start operation. In order to guarantee the free flow of essential goods and services during the COVID-19 crisis, the European Commission (EC) established the "Green Lane" border crossings, in which the crossing times, including any checks, should not exceed 15 minutes on internal land borders.

GMV has developed a new technological platform that will allow the monitoring of the correct operation of the "Green Lanes" in any scenario, whether it is a persistent pandemic or post-pandemic, health or humanitarian crisis.

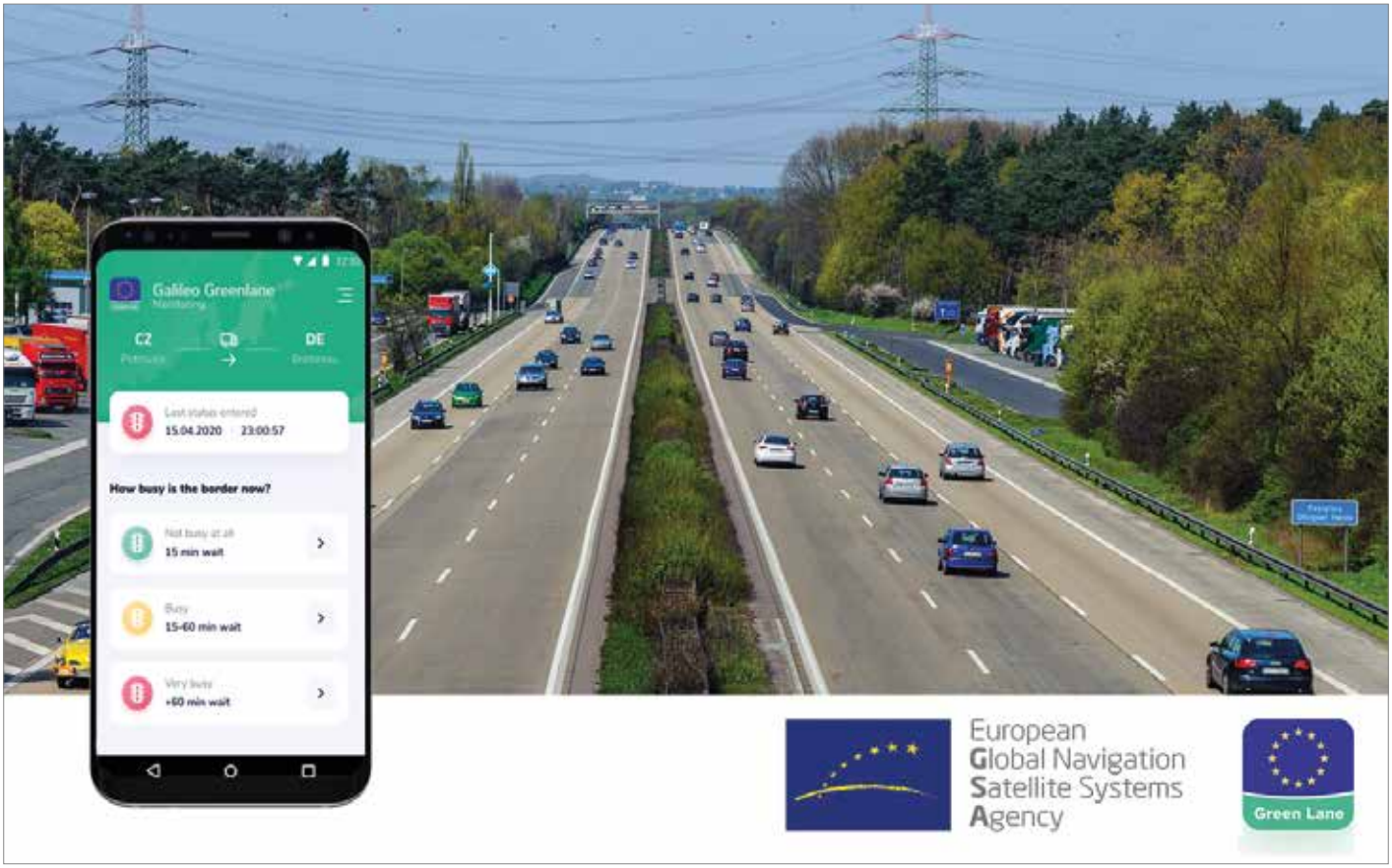
The platform devised by GMV will allow integrating information from several data sources, including the main European traffic aggregators, public entities, fleet management operators so that the system can analyze the available data and provide a reliable snapshot of the waiting times in the border crossings.

The system developed by GMV also includes smartphone applications, both on the iOS and Android Operative Systems, which allow using the smartphones of the drivers themselves when they are driving in the vicinity of a border crossing to monitor the crossing times. It also will provide drivers and transport operators with the expected waiting times at the borders, so that they can take the information into account when planning their itineraries.

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

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

The gathered data will allow the EC to analyze the behavior of the delays in the different border crossings between member states and surrounding countries, in order to define policies to guarantee the compliance with the European Commission Communication C(2020) 1897 final, on the implementation of the Green Lanes to protect health and ensure the availability of goods and essential services.



CUCO project: Optimization of satellite-image acquisition

Driven and led by GMV, CUCO aims to push back the quantum algorithm envelope and apply this new knowledge to a series of proofs of concept in various strategically important sectors

Quantum computing is a groundbreaking technology that represents a great stride forward in computing and IT processing, working as it does with qubits and quantum mechanics instead of the binary bit of classical digital computing. GMV has led and driven CUCO, the first great quantum computing project at national and business level, seeking to push back the quantum algorithm envelope and apply this new knowledge to a series of proofs of concept in various strategically important sectors of Spain's economy, such as energy, finance, space, defense and logistics.

Use cases abound in space, logistics and finance. Taking these in order: in space, earth observation can be used to combat climate change and protect the environment; in logistics, full information traceability throughout the whole supply chain can be achieved, while in finance, the advantages of this technology can be weighed up and the opportunities it offers for optimization and simulation of complex calculations.

Satellite-based earth observation is tackling a very diverse range of challenges, such as the analysis of images taken in different radiation bands or electromagnetic emission. For instance, in any set of satellite-orbit images a decision has to be made on which subset should be taken to optimize certain readings such as the benefit, importance, capacity, etc. It is rarely possible to take the complete set of requested images; the satellite orbit is fixed and there are constraints on the possible combination of images that might be captured.

Precise image acquisition is a habitual, complex and time-consuming task of satellite operators, so any reduction in algorithm running time could represent a competitive advantage. With only 30 images the selection is already fairly complex. In practical terms the problems to be solved involve thousands of images and any classic algorithm will inevitably fall short. It is therefore necessary to directly dispense with exact methods and obligatorily turn to meta-heuristic algorithms, whose running times and guarantees could be enhanced by quantum algorithms. An example might be Quantum Annealing (QA), which comes in particularly useful for optimization of image acquisition.

The CUCO is subsidized by Spain's Industrial Technology Development Center (CDTI in Spanish initials) and supported by the Spanish Ministry of Science and Innovation (*Ministerio de Ciencia e Innovación*) under the national Recovery, Transformation and Resilience Plan.

GMV in the colloquium Transition towards a new industry model: manufacturing sector

Last June GMV took part in the breakfast-colloquium “Transition towards a new industry model”, put on by the enerTIC platform in Madrid, focusing on the manufacturing sector. The event featured top energy and digital-transformation experts together with specialist technology providers of this market to look at the challenges and opportunities thrown up in the drive towards a more competitive and sustainable industry.

GMV’s, Miguel Hormigo, manager of the company’s industry sector, took part in a colloquium discussing the application of technology and digitalization in the interests of this key sector’s energy efficiency and sustainability.

This sector’s diversity and high productivity might be jeopardized by all the challenges it now faces: high energy costs, CO2 emission constraints, supply chain problems, consumers more concerned about sustainability, greater client demands to comply with Environmental, Social and Governance (ESG) principles and the need of boosting worldwide competitiveness. This underlines the need to digitally transform the sector and innovate. With the support of technology, companies will be able to monitor processes, interconnect production plants, control energy consumption and improve decision-making procedures, with a positive knock-on effect on business and sustainability.

People Analytics, smart talent management

People Analytics can bring many benefits to any organization, such as pinpointing the best candidate for any given post; providing personalized training; and ascertaining people’s level of satisfaction and motivation to head off any disenchantment.

In recent years human resource departments have been revolutionizing their talent-management procedures. The new working models brought in by the pandemic, the skills shortages in some sectors, a change in priorities and continuous learning stand out as some of the main challenges to be tackled today.

Faced with this scenario, human resources teams are now finding a great ally in technology, helping them to keep up with the times, making their tasks easier, quicker and more effective. Big data and business analytics techniques enable us to compile data, analyze it, draw valuable conclusions and make strategically important decisions that help to manage the talent of their teams and keep ahead of the technology curve.

People Analytics features large among these techniques. Based on data analysis this procedure gives a more complete overview of any company’s staff, listening to and learning about their needs and identifying room for improvement in decision making. The upshot is an increase in staff satisfaction, leading naturally to a concomitant increase in productivity.

GMV would argue that People Analytics represents a chance for organizations of any sector to optimize human talent management, with a great saving of time and cost. It also comes in handy for attracting, identifying and developing talent and encouraging its loyalty, finding out the state of the organization’s culture and gauging the performance of new initiatives to keep ahead of the game.

Opinion

Technology and innovation come together to boost AI takeup in the value chain

Digital transformation projects are marking a watershed in some of the economy's most important sectors. Organizations' technological innovation efforts are streamlining processes and enhancing productive efficiency, opening up a very promising future for industry as a whole.

Along this digitalization path it is necessary to discern where each sector and business stands, needs varying accordingly. Some companies focus on product traceability and more efficient data management; others choose to reshuffle their production chain to suit the new market, with a lower, more personalized demand.

Transforming projects: AI in the farming sector.

With the overall aim of ascertaining the applicability and feasibility of artificial intelligence (AI) and other groundbreaking technology in the value chain, GMV has been running the "AgrarIA" project. The first phase centers on the development of an inhouse integrated platform merging the main processes of the farming sector value chain in a single decoupled computing entity, tapping into the synergies and favoring the rollout of one-off initiatives or use cases that favor a rapid, efficient, productive and sustainable farming transformation.

As for farming output, an investigation will also be made of the use of AI in diverse aspects such as new biopesticides and their dosing in greenhouse crops, optimization of crops on the basis of the plants' hydric and nutritional demands and the planning and autonomous running of farming vehicles for production tasks.

As regards farming transformation, investigation of the use of AI in diverse aspects such as quality forecasts, processing of packaged products and optimization of the farming transformation process itself.

Lastly, zooming in now on farming distribution practices, an investigation will be made of advanced AI algorithms for aspects such as machines and processes for optimization of distribution, storage, forecasting of demand and orders, and dispatch planning.

Eric Polvorosa
Marketing and Communication
GMV's Secure e-Solutions sector

"Organizations' technological innovation efforts are streamlining processes and enhancing productive efficiency"

GMV at APD Innovación

Last June, in the Bilbao Exhibition Centre, the Management Progress Association (*Asociación para el Progreso de la Dirección*: APD) put on the 2nd International Innovation Congress (*II Congreso Internacional de Innovación*). Luis Fernando Álvarez-Gascón, general manager of GMV's Secure e-Solution sector and president of the Forum of Innovating Firms (*Foro de Empresas Innovadoras*), acted as moderator of the discussion panel "Innovation Methodologies, Tools and Mechanisms".

The executive's speech brought out the telling fact that little more than 20% of Spain's firms employing over 10 people see innovation as the path towards sustainable development, according to the figures published by Spain's National Statistics Institute (*Instituto Nacional de Estadística*: INE). Spain lags behind Turkey and does not even reach one half of Italy's rate and even less of Germany's. This innovation shortfall begs the question of just what is the barrier Spain's firms are running up against, as the first step to finding the measures that might remedy this situation.

The debate also addressed the usefulness of an R&D system based on certified standards, reaching a consensus that innovation, as a process that takes place inside organizations, would benefit greatly from clear guidance by coherent standards. Other needs were also discussed, such as setting aside a suitable innovation budget, giving managers leeway to act, establishing innovation metrics to serve as indicators' of the efficiency or otherwise of the process underway and solid sponsoring of projects.

The panel also agreed that innovation should be approached from an open mind, and the importance of seeking collaboration with organizations of suppliers, clients, etc. Fundamental too was the maintenance of a common, cohesive purpose and systematizing the whole process by means of measuring-, controlling- and marking-tasks. Panelists concluded that innovation has to have immediate success, albeit modest, to generate more collaboration.

Álvarez-Gascón wound up the discussion by stressing the role of digital technology in the development of innovation and argued that ICT itself incorporates innovations that solve firms' daily problems and also serve to keep the ball rolling. He cited the examples of blockchain, artificial intelligence and robotics in the services sector.

GMV attends the 19th COTEC Innovation Summit

The COTEC Innovation Summit 2022, held on 28 and 29 June in Aveiro (Portugal), brought together business leaders, entrepreneurs, science and technology organizations and politicians to share their experiences and learn how to apply technological advances in the reinvention of organizational and productive processes.

GMV's João Sequeira gave the company's take on the future of technology and cybersecurity, their increasing importance in businesses and impact on business continuity management, the prevention of possible threats and the need to keep firmly in view the three main vectors of the sector: people, processes and technology.

Planned around four main themes, industrialization, sustainability, knowledge and competitiveness, COTEC Innovation Summit 2022, returning to onsite mode, looked in some depth at all the following issues: the "Future Factory" and its potential for transforming the production chain; the companies championing sustainability as a key business principle and competitive advantage; the revolution in national logistics and transport infrastructure; specialization driven by modular innovation, product platforms and the ease or otherwise of company access to scientific and technological knowledge.

Technology is obviously bound up with business development, with cybersecurity to the fore. GMV thus naturally gave its take in one of COTEC's most important innovation events.

COTEC Portugal is a multisector business association whose remit is to make companies trading in Portugal more competitive by developing innovation and bringing its importance to wider notice.

GMV at Digital Tourist 2022

On 9 and 10 June Benidorm hosted "Digital Tourist 2022", organized by the Spanish Association of Electronics, Digital Contents and ICT Companies (*Asociación de Empresas de Electrónica, Tecnologías de la Información, Telecomunicaciones y Contenidos Digitales*; AMETIC). This flagship tourism event brought together bosses of smart tourism destinations and technology companies like GMV, to swap notes and compare experiences at a time when tourism, once of Spain's top sectors, is recuperating from COVID.

Joan Antoni Malonda, GMV's Tourism Business Developer, took part in the discussion panel "From the smart destinations platform to a new data ecosystem", where he set out the advantages of sharing digitalization data and experiences for both destinations and the tourism firms themselves. He also argued that one of the problems of this data sharing is ensuring its security and privacy.

Malonda talked about the inhouse GMV tools to guarantee this security and privacy, making it possible to transfer information securely while respecting privacy and confidentiality rules by using (Privacy-Enhancing Technologies: PET). PETs facilitate the setting up of a federated network with complete sovereignty of each member in terms of deciding what to share and with whom, making sure this information sharing is carried out under ideal conditions of privacy and confidentiality. Once again, technology becomes an ally, enabling a tourism data model now being driven by the European project GAIA-X and its Spanish Hub.

GMV showcases its range at SmartPorts

On 16 June Madrid hosted the "SmartPorts" encounter, organized by the Executive Forum Spain with the collaboration of the Spanish Transport Association (*Asociación Española del Transporte*) and Eurotech. In this sixth SmartPorts GMV, together with representatives from the ports of Algeciras, Valencia, Barcelona, Huelva and Castellón, talked about its knowledge and experiences of technology's role in the improvement and modernization of maritime transport.

GMV was represented by Manuel Gómez, Business Partner in Public Digital Services for Critical Infrastructure, whose speech centered on data spaces and the economic transformation that might arise from their development, both inside companies by improving their management procedures and outside by opening up new business opportunities.

Manuel Gómez also argued that the current juncture offers a regulatory framework for strict control of data management across the board, while also laying down the bases for data sharing and cheapening processing procedures. Further progress is also needed toward architecture-defining standardization that also establishes management models to guarantee compliance with security and privacy demands. For this purpose GMV has developed ***uTile***, a PET tool to extract insights from data held by several different data subjects without moving this data from its original site.

Stocktaking of the AgrarIA project

GMV's Madrid offices hosted a get-together of the AgrarIA project members to take stock of progress and working lines led by each organization.

The company was represented by data and robotics engineers, who ran through their research activities concerning the use of artificial intelligence for farming production, transformation and distribution.

AgrarIA's aim is to weigh up the feasibility and applicability of artificial intelligence and other technology as real solutions for defining new farming production methods to make Spain's farming sector more technological, innovative, sustainable and energy efficient, to reduce the carbon footprint. AgrarIA is a 24-organization consortium of major firms, SMEs, research centers and universities, setting up a research network determined to meet the ambitious project goals.

These members include technology firms from various fields of robotics, such as Kivnon, Dronetools and Helix North, or artificial intelligence like GMV; cutting-edge research bodies in various technologies such as Salamanca University in AI/multi-agent systems, CSIC in quantum artificial intelligence, Seville University in farming monitoring, ITCL in crop quality forecasting and augmented reality, plus expert firms in the farming sector and other leaders such as Florette, Familia Torres or Casa Ametller.

AgrarIA is funded under "Artificial Intelligence R&D Missions" of the Secretary of State for Digitalization and Artificial intelligence (*Secretaría de Estado de Digitalización e inteligencia artificial*: SEDIA) of the Ministry of Economic Affairs and the Digital Transformation (*Ministerio de Asuntos Económicos y Transformación Digital*) (Case No. MIA. 2021.M01.0004), corresponding to funds of the Recovery, Resilience and Transformation Plan.

GMV at the 16th Modelling Week

From 13 to 17 June the Universidad Complutense de Madrid hosted the 16th Modelling Week as part of the Master in Mathematical Engineering; its aim is to promote the use of mathematical methods and models in research, industry, innovation and management of the knowledge economy.

In this scenario GMV challenged students of this university's Master syllabus to solve a problem set by Antón Makarov and Juan Miguel Auñón-García: how to optimize satellite image acquisition using quantum techniques. This challenge ties in with the CUCO project, promoted and led by GMV, for research into quantum computing applied to crucial industries of the Spanish economy such as energy, finance, space, defense and logistics.

During the first day students were given an introduction to the problem plus documentation to help them understand the issue better. During the rest of the week the students knuckled down to data analysis and implemented some classic algorithms, formulating the problem from a quantum point of view and implementing basic quantum algorithms to solve the problem and discuss the results afterwards. By the end of the week students had achieved an in-depth knowledge of the problem and the methods used to solve it, plus the road head for further study of the matter if they so wished.

GMV, yet another year at AMETIC Santander

Under the banner theme "Sustainable and Digital Reindustrialization: The Great Challenge" the Digital Economy and Telecommunications Encounter kicked off last 31 August, the yearly meet held in Santander to assemble Spain's digital industry leaders. GMV, a stalwart of this event, featured as sponsor while also taking part in two innovation and cybersecurity think tanks.

Organized by the Spanish Association of Electronics, Digital Contents and ICT Companies (*Asociación de Empresas de Electrónica, Tecnologías de la Información, Telecomunicaciones y Contenidos Digitales*; AMETIC) as part of the summer courses of Universidad Internacional Menéndez Pelayo (UIMP), this 36th encounter brought together leading figures from both the public and private sector who, together with top experts, debated the role of digital industry and its impact on Spain's economy and broader society, while also defining necessary actions to exploit the full benefits of digitalization and sustainability for a quick economic recovery.

On the first day of the encounter, Luis Fernando Álvarez-Gascón, general manager of GMV's Secure e-Solutions sector and AMETIC vice president, moderated the discussion panel "The impact of innovation on reindustrialization and strategic autonomy", accompanied by leading professionals such as Javier Ponce, general manager of Spain's Industrial Technology Development Center (CDTI in Spanish initials), Francisco Marín, vice president of the R&D Commission of the Spanish Confederation of Business Organizations (CEOE) and member of AMETIC's Reflection Group, Carlos Artal, general manager of AYMING, and Manuel Ángel Cantalapiedra, Chief Digital Solutions Officer Europe of Grupo Santander.

The experts argued that Spain's innovation rate, holding a lowly 30th place in the R&D investment ranking, is falling off the pace. They also looked at what they see as the main barriers to business innovation in Spain, such as an over-complex system and general underestimation of the importance of innovation.

The second day, moderated by Antonio Cimorra, director of AMETIC's Digital Agenda and Sector-Based Studies, tackled the issue of "Cybersecurity Keys in the Supply Chain". Javier Zubieta, marketing and communications manager of GMV's Secure e-Solutions sector, explained that one of the company's main principles is design-up security to head off any grave consequences from a cyberattack. He also recommended previous assessment of the vulnerabilities of any software to be used in any application; far too often companies do not even keep an inventory of the software they use.

GMV joins UN Global Compact

GMV's commitment is a testament to its aim of becoming an even more sustainable business and bolstering its activity around various targets of the Sustainable Development Goals (SDGs)

As a declaration of its firm commitment to innovation-led, progress-seeking sustainable development, technology multinational GMV has joined the United Nations Global Compact, a worldwide initiative. With this step, GMV takes up and assumes the legacy of one of its subsidiaries, which joined the Global Compact in 2014.

The Global Compact is the world's leading corporate sustainability initiative. Its primary mission is to call on the business sector to act in line with ten universally accepted principles on human rights, labor standards, the environment and anti-corruption. The Global Compact currently boasts a network of over 19,000 participating organizations from more than 160 countries and 70 local networks.

Since its inception, GMV's mission and vision have been underpinned by ethical values that permeate every level of the organization and are aligned with the very mission and vision of the Global Compact. GMV's values rest on the promotion of ethical, honest, and upright behavior; equal opportunities and non-discrimination; information transparency and truthfulness and respect for its confidentiality; zero tolerance of corruption, bribery, money laundering and terrorist financing; strict compliance with the law and applicable regulations, such as the industrial and intellectual property rights of both GMV and third parties; responsible use of the company's resources; and excellence and rigor in the fulfillment of responsibilities towards third parties.

The Global Compact also carries the mandate of the United Nations to advance the Sustainable Development Goals (SDGs) in the business sector. In this regard GMV has developed a wide range of projects and solutions in the various industries in which it operates, making notable contributions to achieving the goals adopted by the UN General Assembly in 2015. The company's commitment to this initiative is also a testament to its aim of becoming an even more sustainable business and bolstering its activity around various targets of the SDGs.

GMV among the best companies to work for

GMV has obtained a remarkable position in Actualidad Económica's Best Companies to Work For in 2022 Ranking. This Spanish ranking puts GMV ahead of companies operating in the same sectors where the company carries out its activity.

The company appears for the first time in this Spanish ranking, which is based on the results of a questionnaire made by independent consultants and experts in different Human Resources fields, such as talent management, retributive and compensatory policies, work environment, training strategy and Social Corporate Responsibility. This result is due to GMV's corporate vision based on manpower as one of its pillars.

In this ranking, *Actualidad Económica* highlights GMV's initiatives that balance work and family life. For example, the successful implementation of flexible working models.

GMV is proud to have this recognition and will continue working on its value proposals.

GMV's history: a journey in time

On 13, 14, and 15 July in Santander, the Menéndez Pelayo International University (UIMP) hosted the course "Competitive Opportunities for Spanish New Space: Technology, Impact, and Society," a forum to discuss the industry's potential, challenges, and necessities.

The event was split into three blocks: technology and industry, space impact, and space and society. A series of round tables, talks, and presentations provided a forum for discussion on the most topical affairs in the Spanish space industry. Speakers included renowned figures from the world of science and technology, from government representatives such as the Secretary General for Industry and Small and Medium-sized Enterprises, Raúl Blanco, and the Secretary General for Innovation, Teresa Riesgo, to representatives of institutions such as the European Commission, the European Space Agency (ESA) and NASA, as well as other scientific bodies and European companies.

GMV's CEO, Jesús Serrano Martínez, had the chance to talk about the company's evolution on Wednesday 13 July when he presented "GMV's history: a journey in time from employee 1 to 2,500". In it, he spoke about the company's origins, the space context in which it found itself, and its trajectory from the mid-1980s to the present day, where it holds a position of leadership that has enabled it to become the sixth largest industrial group and the number one mid-cap in the European space industry, servicing nearly 900 satellites worldwide.

In addition to the major projects that GMV has undertaken throughout its history and the customer portfolio it has built up over the years, Serrano spoke about the importance of European space organizations such as ESA and the European Commission, trends in the space market, and what a company like GMV can contribute to the future of the industry.

GMV, an example of innovation

On July 8 the Digital Spain 2026 meeting took place in Madrid, bringing together the public and private sectors to discuss the main initiatives set up under this plan. GMV's president, Mónica Martínez, attended the meeting and participated in the round table on R&D.

Digitalization, reindustrialization, and science are the three dimensions being emphasized in the Digital Spain Agenda, a program launched in July, 2020 to promote the country's digital transformation as a driver of modernization and a strategic pillar for recovery from the pandemic.

The First Vice-President of the Government of Spain and Minister for Economic Affairs and Digital Transformation, Nadia Calviño, opened the meeting with a speech that focused on digitalization as a key lever for modernizing Spain. She pointed out that Digital Spain 2026 is the digital arm of the Recovery, Transformation and Resilience Plan, the name given to the Spanish strategy for coordinating and managing European funds to repair the damage caused by the COVID-19 crisis.

Throughout the event, a number of outstanding projects already working to transform Spain's economic model were highlighted by the top-level panelists taking part in the various round tables discussions. On behalf of GMV, President Mónica Martínez took part in the discussion titled "Championing R&D," which was moderated by the Secretary General for Innovation of the Spanish Ministry of Science and Innovation, Teresa Riesgo.

In her remarks, Martínez highlighted GMV's early days in the space industry, as a business with a high potential for innovation and one of the first to go digital. This has allowed the company to lead many digital transformation projects, such as TARTAGLIA or CUCO. Martínez also underlined the importance of the funds to help drive rapid recovery in the automotive industry by strengthening innovative capabilities through key technologies for self-driving and connected vehicles. This is the case of the R3CAV project (Robust, Reliable and Resilient Connected and Automated Vehicle for people transport).

The event was also attended by Margrethe Vestager, Executive Vice-President of the European Commission; Reyes Maroto, Spanish Minister for Industry, Trade and Tourism; Joan Subirats, Spanish Minister for Universities; Diana Morant, Spanish Minister for Science and Innovation; Raúl Blanco, Spanish Secretary General for Industry and Small and Medium-sized Enterprises; and Carme Artigas, Spanish Secretary of State for Digitalization and Artificial Intelligence.

The president of the Spanish government, Pedro Sánchez, delivered the closing address, during which he highlighted the source of opportunities offered by digitalization and the importance of frameworks such as the Digital Spain program in modernizing the economy, regenerating the productive fabric, and achieving greater social cohesion.

Team GMV, the best ambassadors of the corporate brand

GMV boasts a fine team of people who act as company ambassadors. They stand for the company's identity and show the utmost commitment to its core values

Over and beyond the logo, the graphic elements, the corporate material or the website, the brand image is made up too by the company's values, the company's way of relating to others and its hallmark features and traits. For this very reason GMV's team of professionals play a crucial role and wield a great responsibility for keeping up the company's reputation and image.

In today's society the figure of the influencer has come into its own, people who whip up interests in their community by way of shared content, stories told, not only on social media but also within their own particular social milieu.

GMV boasts a fine team of people that act quite naturally as torchbearers for the company. By attending conferences, encounters, chats or making visits, by their contributions to the company's blog or other forums, they show the highest possible degree of commitment to GMV's core values and boost the brand image.

The list of GMV's standard-bearers is too long to run through here, almost as long as the company's team itself. By way of example we wish to use this section for giving two colleague's accounts in recognition and thanks for all those whose time and example is always helping to enhance the company's image both inside and outside its offices.

From left to right: Ángel J. Gavín y Bernard Casado

Ángel J. Gavín

Any joke that needs to be explained, they say, is no joke in the first place. Similarly, explaining why one feels and shares the brand of the company one works for should not be spelled out in words. The pride of belonging to GMV, bearing its colors wherever you go, is a feeling. Everything else stems from that.

Sport fans identify themselves with the achievements of their teams and favorite sportspersons. They congratulate them and talk about them on social media. No one makes them do it. It's a cocktail of feelings that takes in happiness, passion, pride, membership, admiration. And a sense of reciprocity. I usually share and celebrate the feats of GMV, of my colleagues and even my own and do so out loud, publicly, on LinkedIn, Twitter or wherever else I'm able to. This is not a calculated or planned program. It's simply a heartfelt instinct.

We are a recognized company, respected in all the areas we trade in. But GMV is more than that. It's passion for what one does, talent, continual personal- and career-development and a nonstop desire to do even better than before. As if that were not enough, this is all done while working with cutting-edge technologies and in thrilling sectors for any go-getting professional. I've now been with GMV for 22 years and I still can't guess what challenges and technologies might be lying ahead. Just as in sport, passion is catching.

And, yes, a dash of "preening" does come into it sometimes. I like talking about GMV to my friends and contacts. I've encouraged more than one to join the firm. Because ... how could I not want to be surrounded by the best professionals, by people I'm convinced will fit into GMV's culture and DNA and will help us all to be that little bit better!

Bernard Casado

From my very first day in GMV right up to now, nearly 5 years later, my line bosses and colleagues have always infused me with great confidence as part of the reigning respect and fellow feeling within the whole company. From the very first moment you feel part of a family; this easy-going seriousness has made me want to give the very best of myself and return the compliment to the company itself, giving as much value and support as I've received.

GMV, ever faithful to its hallmark values, is always ready to help its employees spread their wings and try out other working environments within the company. For that reason I'm always 100% ready to help out too, well beyond my ostensible remit, not only as a way of returning all the day-to-day support I receive but also in order to learn new skills and take on new knowledge.

Right from the very start of my company career, therefore, I've always been keen to collaborate in such important tasks as all the following: pre-sales techniques, bringing our range of hi-tech products to the notice of major clients; university lectures, allowing me to explain to students interested in cybersecurity and the new computing paradigms how GMV brings its influence to bear on industry and how it might help them to develop their own careers; intern training, seconding the whole companies' responsibility for encouraging budding talent and helping its team of professionals to get the very best out of themselves across the board, not only in their professional duties; and representing the company in summits or supplier forums, among many other activities.

After this whole time of unforgettable experiences, I couldn't be prouder of belonging to this company and helping it to prosper and grow, upholding the values all companies should share: confidence, respect and high performance.

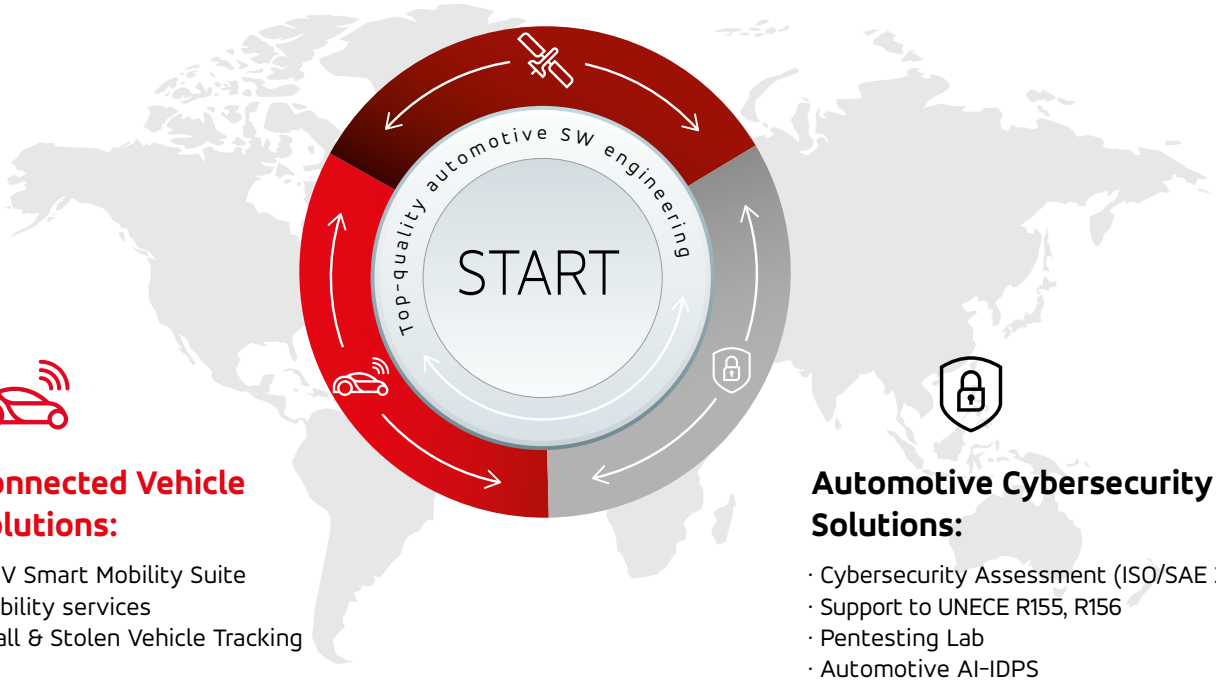
GMV Automotive Technology

GMV's automotive technology is based on 3 thrusts: GNSS-based autonomous vehicle positioning systems; automotive cybersecurity for developing specific products and services; the connected-vehicle area, bringing into the equation technology related to V2X communications, mobility services, telematic services and the development of secure and dependable software. These three thrusts are mutually complementary.

gmv_aut@gmv.com

GNSS Positioning Suite for Autonomous Driving:

· ***GMV GSharp*** for Automotive



Connected Vehicle Solutions:

· GMV Smart Mobility Suite
· Mobility services
· eCall & Stolen Vehicle Tracking

Automotive Cybersecurity Solutions:

· Cybersecurity Assessment (ISO/SAE 21434)
· Support to UNECE R155, R156
· Pentesting Lab
· Automotive AI-IDPS

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