

Towards sustainable space: the satellite traffic and space-debris challenge



INTERVIEW
Holger Krag
Head of ESA's Space Safety Programme



73rd International Astronautical Congress

18-22 de September. Paris, France

The International Astronautical Federation (IAF) will once again be holding its 73rd International Astronautical Congress (IAC 2022) in Paris Convention Centre, from September 18 to 22.

Under the title “Space for @ll”, IAC 2022 will offer an extensive and multidisciplinary technical program of sessions and conferences covering a wide range of disciplines within the space sector.

As well as running its own stand (J2), GMV will also have a space in the pavilion of the public business organization ICEX, where it will be presenting various technical items and giving various presentations.

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Letter from the president

Problems begin in the movie Gravity when a missile destroys a satellite. Its fragments collide with other satellites, producing more and more fragments that end up crashing into the shuttle of the astronauts that are the protagonists of the movie. Space debris proliferation in reality happens much more slowly. Even so, space debris is a reality, and its origins are indeed partly due to satellites destroyed by missiles, although most of it is launcher remains, loose pieces and inactive satellites that have completed their missions. The first pieces of space debris were produced at very beginning of the space race: Sputnik's protective layer and launcher coupling parts. The problem is that satellites and space debris move at very high speeds of approximately 10 km/s, 20 to 30 times faster than the bullet of a gun, and therefore any collision with one of these objects, no matter how small it might be, can cause serious damage. The amount

of space debris accumulated for over 60 years now poses a very real danger to active satellites and even to the astronauts in the International Space Station.

In order to be able to divert active satellites that are on a path to collision, space debris must be very closely monitored. GMV is leading the development of space surveillance systems for several European countries, and we provide collision avoidance services to over eighty satellites from ten different commercial operators. We also participate in R&D projects of the European Space Agency for hunting down inoperative satellites to divert them to the atmosphere, where they are destroyed due to the friction heat caused by their extremely high speed. We need to take care of our environment, which we are already expanding beyond the Earth's limits.

Mónica Martínez

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CONTENTS

Published
GMV

Editorship–Coordination
Marta Jimeno, Marta del Pozo

Area Heads
Antonio Hernández, Miguel Ángel Molina, José Prieto, Javier Zubieta

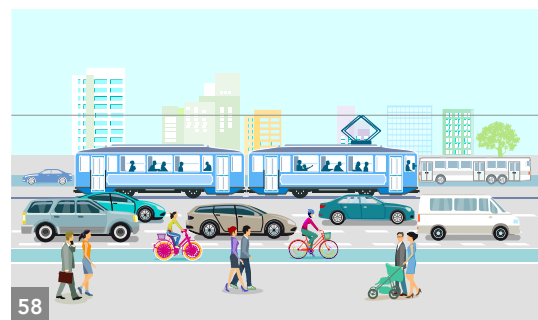
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3 LETTER FROM THE PRESIDENT

6 ARTICLE

Towards sustainable space: the satellite traffic and space-debris challenge

12 INTERVIEW

*Holger Krag
Head of ESA's Space Safety Programme*



6



12



16



36



40



52



70



76



81

16 AERONAUTICS

GMV primes the contract to define a new EGNSS service for drones

20 SPACE

GMV cements its leadership in collision avoidance operations automation and coordination in Europe

36 ROBOTICS

The Robotic Digital Twin projects comes through its critical design review with flying colors

40 DEFENSE & SECURITY

GMV firms up its position as a tried and tested supplier of the European External Action Service

46 CYBERSECURITY

Industrial Cybersecurity: All-in approach in a digital transformation environment

52 HEALTHCARE

Diagnosing illnesses in outer space

58 ITS

GMV wins the contract for the management system of Bilbao and Vitoria's trams

66 AUTOMOTIVE & MOBILITY

Opinion | Management of low-emission zones, urban tolling and mobility innovation

70 ICT

Crop yield prediction using quantum computing

76 CORPORATE INFORMATION

*Interview to Soledad Cardozo Salazar
International Strategic Partnerships Manager of the Spanish
ACNUR Committee*

81 TALENT

Boomerang employees: when values come first



Towards sustainable space: the satellite traffic and space-debris challenge

Space debris poses a stiff challenge for the security and sustainability of future space operations, not only for our generation but also for the ones to come.

Since the start of the space race, kicking off with Sputnik in 1957, thousands of launches have placed over 13,000 artificial satellites into orbit. About 6000 of these are still active, operating in an increasingly congested scenario that endangers their current operations and future access to space. To make matters worse, several thousand new satellites are due to be launched in the coming years, including large, low-orbit constellations.

The European Space Agency (ESA) estimates that a total of almost 10,000 tons of material is currently orbiting our planet, including over a million objects bigger than 1 cm, all of which could render any satellite useless on impact. A constant watch is kept on only about 30,000 of these objects, typically bigger than 10 cm. The other unmonitored objects orbiting our planet make up what is known as space debris.

Apart from the launched satellites themselves and the final launcher stages that have placed them in orbit,

the main source of this huge number of objects is collisions between two orbiting satellites (witness the 2009 collision between a US communications satellite and an old Russian satellite at a height of 790 km), satellite explosions (especially old satellites or final launcher stages improperly passivated at the end of their useful life) and anti-satellite tests such as those carried out by China in 2007 (the source of the great majority of today's space debris), by the USA in 2008, by India in 2019 and, most recently, by Russia in November 2021.

This doesn't seem to pose a serious threat to life on earth. Satellites, however, depend heavily on our communication, earth-observation and navigation capabilities, etc. The development of our society is heavily space-dependent, so space has to be viewed as an environment to be preserved. This is particularly so in the case of low and geostationary orbits (the busiest and most coveted), around which protection zones have been defined. Consideration has to be given too to the crewed space stations

orbiting the earth (for which space debris poses a considerable risk) and ambitious plans now underway to develop space tourism.

The likelihood of collision between two objects in space is low but this probability is continually edging up with the growing number of objects. Given the current congestion of space and the number of scheduled launches, the probability of catastrophic collisions is growing too. Such collisions could imply not only the loss of any mission but also fragmentation of the objects and the possibility of sparking a chain-reaction domino effect called the Kessler syndrome. This would create a cloud of objects in the affected orbits with the consequent exponential increase of collision probability, making space much more hazardous to access and operate in.

By way of analogy, space debris could be viewed as a sort of illness of the space environment. This illness needs to be prevented, diagnosed, monitored and dealt with in pursuit of an overall cure. This is a global problem calling for global solutions.

PREVENTION: RULES AND STANDARDS TO CURB THE PROLIFERATION OF SPACE DEBRIS

As far back as 2002 the Inter-Agency Space Debris Coordination Committee (IADC), made up by the world's main space agencies, published a series of space debris mitigation guidelines, the last update coming in 2021.

Following on from this work, in 2009 the UN's Committee on the Peaceful Uses of Outer Space published guidelines intended to ensure Long-term Sustainability of Outer Space Activities. These guides have been updated in recent years, the latest dating from June 2019.

In 2009 too an ISO standard was published on space debris mitigating requirements, updated thereafter in 2019. ISO is working on a new standard to ensure coordination of space traffic.

These guides and standards lay down the activities to be avoided by satellite operators to stem the proliferation of space debris. These discouraged activities include intentionally destroying objects in space, while operators are encouraged to perform collision-evasion operations, to passivate old satellites (emptying their fuel tanks and batteries) and send them into graveyard orbits at the end of their useful lives. The trouble is, however, that none of these actions is technically binding, since space is an environment of free access where no legislation can be enforced on all-comers.

But things are changing: some countries are now beginning to draw up legislative and regulatory mitigation initiatives. Witness France's Space Operations Act, passed in 2008 and binding on all French satellite operators. This law includes the famous rule whereby the maximum orbital lifetime after the end of any satellite's useful life is 25 years, by which time it must have reentered the earth's atmosphere.

DIAGNOSIS: MONITOR AND CATALOG SPACE DEBRIS

Space surveillance operations are carried out to monitor the population of space debris: detection, observation and monitoring of these objects by means of diverse sensors from earth (radar, telescopes, lasers, etc) or space (especially onboard cameras). A catalog of orbiting object above a certain threshold size (usually over 10 cm in low orbits and 1 m in high objects) is drawn up from this monitoring information and regularly updated. These catalogs in turn help to assess the likelihood of collisions between operational satellites and space debris, maneuvering accordingly to avoid them. Other services are also rendered such as detection and analysis of fragmentations in orbit or forecasting uncontrolled reentries.

The USA has been a trailblazer here, running a space surveillance system



first set up during the cold war. Its ostensible remit is to detect any launches of intercontinental ballistic missiles. Under this system telescopes and radars have been set up all around the world and they can now be used to catalog these objects. Part of this information is offered publicly, albeit at times with degraded precision and never for space missions deemed to be critical or classified.

In Europe, way back in the nineties, ESA developed applications to monitor and catalog space debris and assess any collision risk with its operational satellites. Since 2009, moreover, it has been developing an ambitious space security program, involving not only space surveillance technology but also planetary defense and space climatology systems.

Europe's defense ministries and the main space agencies are also doing their bit, developing national space surveillance systems over recent years. Taking its cue from these national initiatives, Europe also now runs its own space surveillance system. In 2015 the European Union unveiled a program called EU

Space Surveillance and Tracking (EU SST) for developing Europe's own space surveillance system. EU SST is a federated system, comprising the national systems of several member countries. The initial consortium members were France, Germany, Italy, Spain and Great Britain. Great Britain has recently dropped out, post Brexit, while other EU countries have been brought into the fold, like Portugal, Poland and Romania. In 2023 the consortium is expected to grow to a total of about 15 member countries.

Effectively, in view of the sheer importance of this problem, the EU has decided to put everything behind these initiatives. It has recently published its intention of creating a new European Space Situational Awareness (SSA) and Space Traffic Management (STM) program. In the future this new program will have to become part of Europe's major space programs, together with the longstanding navigation (Galileo and EGNOS) and earth observation (Copernicus) programs and the new European Union Governmental Satellite Communications (GOVSATCOM) program.

CURE AND ERADICATION: REMEDIATION AND ELIMINATION OF SPACE DEBRIS

But the problem's still there. Space debris is eliminated only upon reentry of the earth's atmosphere. Only for objects in the lowest orbits (usually below 800 km) does this occur naturally in fewer than 100 years. Space debris higher than this will continue going round and round for thousands of years.

Space-debris elimination technology is now being developed and new concepts explored. Most of these ideas involve launching a satellite to capture another inactive one (using a net, harpoon or robotic arm, for example) and remove it from protected space zones and, if possible, effect a controlled reentry of the earth's atmosphere in the case of low orbits.

Recent missions of this type include Northrop-Grumman's Mission Extension Vehicle (MEV), which has recently extended the useful life of two Intelsat satellites, and the European demonstration missions, ESA's ClearSpace-1 and Astroscale UK's ELSA-d.



GMV, EUROPEAN LEADER IN DEALING WITH SPACE DEBRIS

GMV is a world leading light in the study, monitoring and prevention of space debris. Its work in this field dates back to the late nineties when it began to work with the European Space Agency (ESA) on activities of object cataloging and in-orbit collision avoidance.

In all, over 80 GMV engineers are now working on space-debris activities in seven different countries (Spain, France, Germany, Great Britain, Poland, Romania and Portugal), making it Europe's biggest space-debris team.

Since 2010 the company has worked on over 30 ESA space-safety projects from all these countries, acting as prime contractor in nearly 20 of them, collaborating with more than 40 firms and research institutes from the whole of Europe. By way of example, GMV is priming ESA's SST Core

Software (including object cataloging, planning of sensors and collision service, reentries and fragmentations) and also ESA's Collision Risk Estimation and Automated Mitigation (CREAM) program; it has also designed Space-Based Surveillance Systems (SBSSs) and Guidance, Navigation and Control (GNC) systems for space-debris-elimination missions. Worthy of particular note is its participation with AVS in the development of the PRINCE concept, which will enable the new generation of EU's Copernicus satellites to be removed from their operational orbits.

Under the EU SST umbrella and the national space-surveillance programs GMV has primed and led contracts in all the abovementioned countries, pride of place going to the following responsibilities:

- In Spain GMV is leading the design, development, integration, management and operation of the Spanish Space Surveillance and Operations Center (S3TOC).

GMV is also priming several EU SST-related R&D studies for Spain's Industrial Technology Development Center (CDTI in Spanish initials). For example, GMV is developing **Focusear**, a passive monitoring system of active telecommunications satellites in geostationary orbits.

- In France GMV has been supporting CNES's space debris activities since 2012. In Toulouse GMV is leading development and operation of CNES' Simulation and Analysis Bench for Space Surveillance System (Banc d'Analyse et de Simulation d'un Systeme de Surveillance de l'Espace: BAS3E), among other projects.
- In Germany GMV is leading maintenance and upgrading of the mission system for Germany's Space Situational Awareness Centre (GSSAC) and development of the basic SSA data processing algorithms (underpinning EU SST's future space-debris catalog) for Germany's space agency (DLR).



- In Romania GMV is leading development, integration and operation of the Romanian space surveillance operations center for the Romanian Space Agency (RoSA) and is also providing the image-processing software of the Romanian telescopes that contribute towards the EU SST.
- In Poland GMV has led development and integration of Poland's space surveillance operations center for the Polish Space Agency (POLSA).
- In Portugal GMV is conducting two R&D studies for Portugal's Defense Ministry in the framework of the EU SST system.
- In the United Kingdom GMV has led eight SST-related studies in the last four years for the UK Space Agency (UKSA), STFC and Dstl as part of GB's contribution to the EU SST and its national initiatives in this field.

GMV is no less of a benchmark firm in the commercial space surveillance market. Since 2017, for example, GMV's commercial operations center has

been running **Focusoc** to provide collision-avoidance services for 10 commercial operators from around the world and over 80 satellites. Drawing on these capabilities, GMV is supporting the Sprint Advanced Concept Training (SACT) collaborative exercises run by USSPACECOM since 2020. To do so GMV works with a whole set of operational software for processing space surveillance data, including simulation and visualization, catalog keeping (taking in correlation, orbit determination and detection of maneuvers), sensor planning and service provision (comprising collision, reentry and fragmentation).

In the military arena GMV is providing the processing software of the space surveillance center of the German Armed Forces (Weltraumlagezentrum) and is supporting the Spanish MoD for definition and development of Spain's space surveillance operations center (COVE). GMV is likewise supporting diverse NATO experiments and participating in the Global Sentinel exercises coordinated by USSPACECOM

since 2018 in support of the Spanish MoD. Finally, GMV is taking part in the 3 space-surveillance projects included in the 2020 call of the European Commission's EDIDP, namely, SAURON (sensors, under the leadership of ArianeGroup), INTEGRAL (space control and command under the leadership of Leonardo) and ODIN's EYE (early detection from space, under the leadership of OHB).

Last but not least, under the space traffic management (STM) heading, GMV is leading a major European consortium for the definition of STM guidelines and practices for the European Commission (EUSTM project). GMV also forms part of the Space Safety Coalition (<https://spacesafety.org/>) and supports the Net Zero Space initiative (<https://parispeaceforum.org/initiatives/net-zero-space/>), presides over the STM working group in EUROSPACE, participates in IAF's Space Traffic Management Technical Committee TC.26 and forms part of Europe's STM standardization working group in European Cooperation for Space Standardization (ECSS), contributing too to the corresponding ISO working group.



Holger Krag

Head of ESA's Space Safety Programme

Holger Krag is the head of ESA's Space Safety Programme Office at ESOC in Darmstadt, Germany.

He took his master in Aerospace Engineering at the University of Braunschweig, followed by a 4-year research period at the Institute of Aerospace System where he focused on space debris modelling and surveillance, which also became the topic of his PhD (2003).

In 2006, he joined ESA as an Analyst in the Space Debris Office at ESOC. In 2014, he took the position of the Head of the Space Debris Office, which, among others, provides fundamental support to ESA's Space Situational Awareness Programme. In 2019, he took over the position as the head of the programme, and prepared the evolution into the new Space Safety Programme which was established at the Space19+ Ministerial in Sevilla.

Krag is the author of/contributor to about 200 publications and has been active in education since many years through lectures at ESA's training center and Technical Universities in Germany.

What are the main activities of the ESA office you run?

Our office is responsible for the implementation of several programs. Firstly, we are managing the SSA Programme that was established in 2009 and is now coming to an end. Most of the elements of the SSA Programme will continue in the Space Safety Programme which is significantly larger and wider in scope. We also implement the tasks that have been entrusted to ESA in the area of Space Weather and Near Earth Objects by the European Commission. Very important for us also is the development of the Spanish Surveillance and Tracking System (S3T) which is implemented by us on behalf of CDTI/MICINN.

All these activities are addressing three domains through industrial research and development contracts: Space Weather observation and warnings, Planetary Defense by which we mean the detection and deflection of critical Near Earth Objects, and Space Debris detection, mitigation and remediation.

Finally, located as it is in ESA's mission control center, our office is also responsible for frequency management of our antennas and spacecraft and for the safety of our missions in terms of collision avoidance.

As head of ESA's Space Safety program, can you give us a nutshell account of this program's remit and main lines of action?

The Space Safety Programme has 5 concrete goals that we want to reach by 2030:

1. Space Weather early warning system tailored to European user needs.

Over the past years we have built up a pre-operational network of expert centers that can process Space Weather data into user products. We are starting to generate operational data in Europe via dedicated payloads. A real flagship in this field will be the Vigil mission that will operate from Earth-Sun Lagrange Point 5. It will

carry, among others, a Coronagraph, Heliospheric Imager and Magnetograph and will use its unique viewpoint to predict the arrival time of coronal mass ejections and other hazardous solar events. It will be the first operational mission from deep space providing near real-time data from a distance of 150 million km.

2. Early warnings for asteroids >40 m about three weeks in advance.

For this, we will rely on a network of ground-based wide-field survey systems. A first instrument, the FlyEye telescope with a FoV of about 50 square degrees in a novel design, is close to its deployment. Three other survey systems are to follow. We are also planning an infrared asteroid detection mission to operate from Earth Sun Lagrange Point 1 called NEOMIR.

3. Capability of deflecting asteroids smaller than 0.5 km (2 years in advance).

The deflection of asteroids requires knowledge of the composition of the body and the effectiveness of the momentum transfer of the chosen mission. Jointly with NASA, with our Hera mission we will conduct the very first demonstration in space using kinetic deflection on the asteroid system Didymoon/Didymos.

4. Established European players for a growing market of space-traffic technologies and products.

For too long, we were led to believe that space-traffic management solutions were to be developed, owned and operated by the public sector. Now, it is very clear that a significant market for business-to-business solutions and services is opening up in this field. We are working with European industry to de-risk associated business cases and enter this market.

5. Prepare European industry for a zero-debris policy and a circular economy in space.

Apart from managing the Space Safety Programme we also implement the tasks that have been entrusted to ESA in the area of Space Weather and Near Earth Objects by the EC

The space sector's debris-mitigation performance has so far fallen well short of its remit. We want to improve this by aiming at a zero-debris policy for ESA missions. Space system disposal actions would therefore have to become more reliable and robust. Where they still fail, in the future, active removal must be mandatory. To achieve such an ambitious policy (and make regulators follow our example), the required technology must be demonstrated and affordable. Our flagship is the Clearspace-1 mission which will conduct the first ever active removal of an existing piece of space debris. Other technology demonstrations such as de-orbiting kits are on their way.

Which are the main ESA activities to tackle the problem of space debris and growing space traffic?

The implementation of a good space debris prevention policy is a high priority for ESA. Related requirements are systematically made applicable to all ESA missions and are followed by an independent entity. Only when debris prevention is mastered successfully and reliably will other actions become meaningful. We publish an annual report on the overall behavior of all spacefarers and we confidently expect this to provide transparency on the situation and stimulate others to speed up implementation of mitigation measures.

As an operations center with about 20 spacecraft operating in Earth-bound orbits, we are confronted with the problem every day. Collision avoidance thus became a normal practice in ESOC



about 20 years ago. Today, this task is becoming increasingly cumbersome and resource-intensive.

Moving on to the space systems, we need to revisit our platforms in order to make mitigation actions more failsafe. Space system passivation and space system disposal must also work after the failure of major functional chains onboard. This requires more redundancy or independent onboard devices that provide this additional redundancy. We focus a lot of effort on these technologies. A challenge not to be forgotten here is the on-ground risk, which might have significant repercussions on spacecraft design. Design-for-demise is an emergency technology that we are driving

The increasing congestion in Space is a result of the overall poor performance in achieving debris mitigation in the past and present

forward and which we would like to foster through the proposed DRACO destructive re-entry mission.

Of course, active removal will become an important element of “policy”, when it becomes a mandatory action as a result of failure. This will not only stipulate a better success-rate in disposing of space systems but also open up a market for the suppliers of removal services.

What are the main causes and effects of increasing space congestion? What future challenges does it pose?

The increasing congestion in space is a result of the overall poor performance in achieving debris mitigation in the past and present. We are still recording about 10 fragmentation events per year and a few dozen space objects are not properly disposed of every year. All this at a time when the use of space is significantly increasing.

This will have two-fold consequences. A short-term consequence is an additional burden for operators. The number of conjunction alerts received for ESA missions has increased significantly. This comes with a cost burden, since manpower, station time and propellant are consumed. Today, there is roughly 1 maneuver every week for the full ESA fleet. A new difficulty is conjunction warnings between two active spacecraft. Here, coordination action is a must.

But this still relies on a manual process a long-term consequence is the self-sustained degradation of the environment due to the increased likelihood of collisions and resulting contaminating effects (collisional cascading). In the worst case, future generations might not have the possibility anymore of using the portions of space that are ideal for some applications (i.e. earth observation from sun-synchronous orbits and communication from lower LEO). In other words, the deployment of the essential space infrastructure for our future life will become more risky and expensive, if not even impossible.

The increased use of space in recent years raises the question of a more coordinated use of space. While other scarce resources (such as the frequency spectrum) are coordinated and all players strive to make more effective use of those resources, in space such a coordination is absent. The problem is that the use of space is less evident and more difficult to quantify. Once a good and acceptable quantification scheme is available this could be used to measure and coordinate the consumption of space and stipulate consumption targets for future missions.

Which would you consider likely to be the main developments in coming years to address these challenges?

Schemes to measure the consumption of space are being developed in the academic sector and are now being compared and discussed. They will be deployed and made available in a transparent way. Should the inherent logic of the schemes be accepted by the international community, future mitigation rulings might make use of these to intensify the implementation of mitigation measures. Missions posing a risk of long-term environmental impacts will show up with a larger computed space consumption and would automatically have to accept more stringent requirements.

Increasing space-traffic and the resulting number of collision warnings underline the need also for more precise surveillance data. The more accurate the data is, the more false alerts can be avoided. It would be a fine goal for Europe to improve state-of-the-art accuracy by a factor of 10. This would lower space operators' efforts by the same factor. This also shows that there is an inherent commercial value. High frequency ranging or space-based solutions could be key solutions. In ESA we are testing the use of ground-based lasers for ranging to non-cooperative targets. First results are promising.

The incidence of collision alerts between two active spacecraft will

rise in the future and will become a significant burden. We are working with industry to propose and develop solutions that provide safe automation of this task. We believe that a good solution will be used and accepted by spacefarers and could be promoted to a de-facto standard. This solution can be owned and operated by private companies. To me it does not look likely that a publically-controlled space management system for maneuver coordination will emerge quickly. It could well be that we see industrial customer-oriented solutions much earlier. When they offer a pragmatic service it will attract the spacefaring community and establish a de-facto standard. A good working standard is then often adapted later by regulators. The necessary “rules of the roads” could then emerge from working practice.

Finally, I hope to see zero debris principles established, which should stipulate the use of the technology introduced before for more fail-safe

disposal and more systematic use of active removal. When this becomes the routine, we might also see publically funded removal actions on objects that have already stranded years before and are a particular challenge.

But we should also think even one step further. Space systems that can be re-used don't need to be removed. I believe we might indeed witness what we call a “circular economy in space”, in which spacecraft are refueled and repaired. The associated in-orbit servicing actions have a high commercial value. They might start out with more simple services, such as life-time extension and re-positioning. However, they could go as far as in-orbit manufacturing and recycling one day.

What role do you expect ESA to play in driving these developments?

The role of a public technical agency like ESA is to make sure that the technology required to master all these challenges is available, demonstrated

and affordable, so that decision-makers and regulators can make use of these tools. We want to raise strong and competitive European suppliers of space traffic management solutions for a global market. A group of stakeholders convened by ESA has shaped a new initiative called PROTECT that defines ambitious goals for Europe in the area of space traffic management. ESA is willing to fulfill its role to achieve these widely shared goals, jointly with member states, the European Commission, Industry and all other stakeholders. In this context, the achievements of the Space Safety Programme could play a meaningful role and future efforts could be steered to meet the European goals of a strong role in the area of Space Traffic Management.

Of course, a very important additional role of ESA, as a spacefarer, is to act as a role model for others, by ambitiously paving the way for new technologies and using them for the benefit of the space environment.





GMV primes the contract to define a new EGNSS service for drones

A GMV-led consortium is carrying out the European Commission's EUGENE (European GNSS Service for UAS) project

The use of drones or, more properly speaking, Unmanned Aircraft Systems (UASs) is soaring nowadays. Under current European regulation the various types of UAS and U-space service operations are being phased in progressively in accordance with their respective risk level.

The GMV-led consortium, including also the companies ESSP, VVA and Unify, are carrying out the European Commission's EUGENE (European GNSS Service for UAS) project, which, kicking off in January this year, aims to define Europe's UAS-orientated GNSS services. This will involve carrying out medium-risk operations (the operational risk can be classed as low, medium or high after methodologically analyzing risks for ground personnel and crewed aircraft in the nearby vicinity).

EUGENE will contribute towards the European Commission's goal of establishing this service, which, in the future, will be a key factor for use of an onboard drone navigation system. The UAS EGNSS service will also be

conducive to correct working of the various U-space services designed for medium-risk operations. This is so because many of them will be based on UAS positioning, such as tracking, traffic-information or conflict-resolution services.

The project will define the requirements, provision scheme and UAS EGNSS service implementation plan. Also factored in will be integration with the services currently provided by Galileo and EGNOS programs, as well as any future upgrades. Furthermore, in order to analyze possible benefits from an economic point of view, EUGENE's outputs will also include a cost-benefit analysis of EGNSS implementation.

The EUGENE project, under GMV's GNSS leadership and tapping into its UAS expertise built up over recent years, means GMV holds onto pole position in the development of Europe's drone-orientated GNSS programs. EUGENE can be seen a continuation of the forerunner EC project in this field: SUGUS, also led by GMV and involving ESSP, Everis, VVA and Unify, ending in 2021.

ADM Sevilla 2022



■ At the beginning of June, a new edition of the ADM (Aerospace & Defense Meetings) was held at the Conferences and Exhibitions Center in Seville.

Those attending this event were able to learn first-hand about solutions in aeronautics, as well as in defense and security at the GMV stand. Among them, its latest developments in systems for intelligence, surveillance and reconnaissance (ISR) in the area of unmanned aerial systems (UAS). In this regard, GMV shared information on Seeker, one of the unmanned platforms that it designs and develops in collaboration with Aurea Avionics.

In this same area, colleagues from GMV present at the fair also shared information on the U-Space family of products, **Dronelocus**®, developed by GMV in order to respond to the growing volume of civil unmanned aircraft that will make use of the airspace in the immediate future.

During the event, the FCC (Flight Control Computer) flight control system for the long-range unmanned tactical aircraft ATLANTE was also presented; the navigation and synchronization system for vehicles of the Armed Forces, ISNAV, which will equip the VCR 8x8 DRAGON, and the control unit for the A400-M crane.

GMV participates in ISUDEF

The International Symposium on Unmanned Systems and the Defence Industry 2022 (ISUDEF) was held in hybrid mode from 30 May to 1 June 2022.

ISUDEF, an international and multidisciplinary symposium, aims to address current issues on unmanned systems and the defense industry in areas such as air, naval and land

applications, avionics and radar systems and air defense.

Researchers presented their solutions and insights on topics such as platform design, AI integration, robotics and autonomous systems to provide groundbreaking solutions to the challenges facing the domestic defense industry, along with civil applications.

GMV took part in the Industrial Special Session Speakers Information, presenting "Artificial Intelligence Aided GNC for Autonomous Operation of RPAs". This paper tackled current operational scenarios in which an RPAS might be used, the new conditions and threats and new Guidance, Navigation and Control (GNC) systems using trailblazing data sources and AI algorithms to boost GNC performance.

GMV participates in the final SAFETERM flight tests



■ June 8 saw the final flight tests of the SAFETERM onboard system in the ATLAS Experimental Flight Center in Villacarrillo (Jaén).

SAFETERM is a European Defence Agency (EDA) project being carried out by GMV in a consortium with AERTEC; it aims to improve Medium Altitude Long Endurance (MALE) RPAS flight termination procedures and systems, and to explore AI-supported avionics system certification procedures.

SAFETERM's main remit is to boost the general safety level in managing emergency situations involving a loss or degradation of the command and control link, plus other failures. It therefore allows for safe flight termination in the event of any failure of the

remote controller's control capacity or autonomy, establishing alternative and safe landing areas by means of artificial-vision techniques. This is an extremely complex task, representing a notable advance on traditional image-processing technology.

Among all the possible artificial-vision applications, SAFETERM is based on zone recognition: i.e., ascertaining which areas appear in the image and where they are located. Another of EDA's goals here is to weigh up the challenges of using AI in aviation. Here is where real avionics software and equipment can be developed to evaluate certification phases for AI-based onboard systems. This will usher in another important aspect of the project: certification- and standardization-support activities.

The aim of the tests conducted in the experimental station, which proved to be a resounding success, was to demonstrate system working in a real environment, using AERTEC's TARIS-75 aircraft. Two emergency operation drills were conducted on different ground features. The system was shown to work properly in real time and was successfully integrated with flight control systems, successfully locating viable flight-termination zones.

After the flight a hybrid-mode workshop was held to present the main results and lessons learned from the project. There was also an open discussion on the possible ways of converting systems of this type into usable projects in a wide range of real operational systems.

One more edition at the "World ATM Congress"

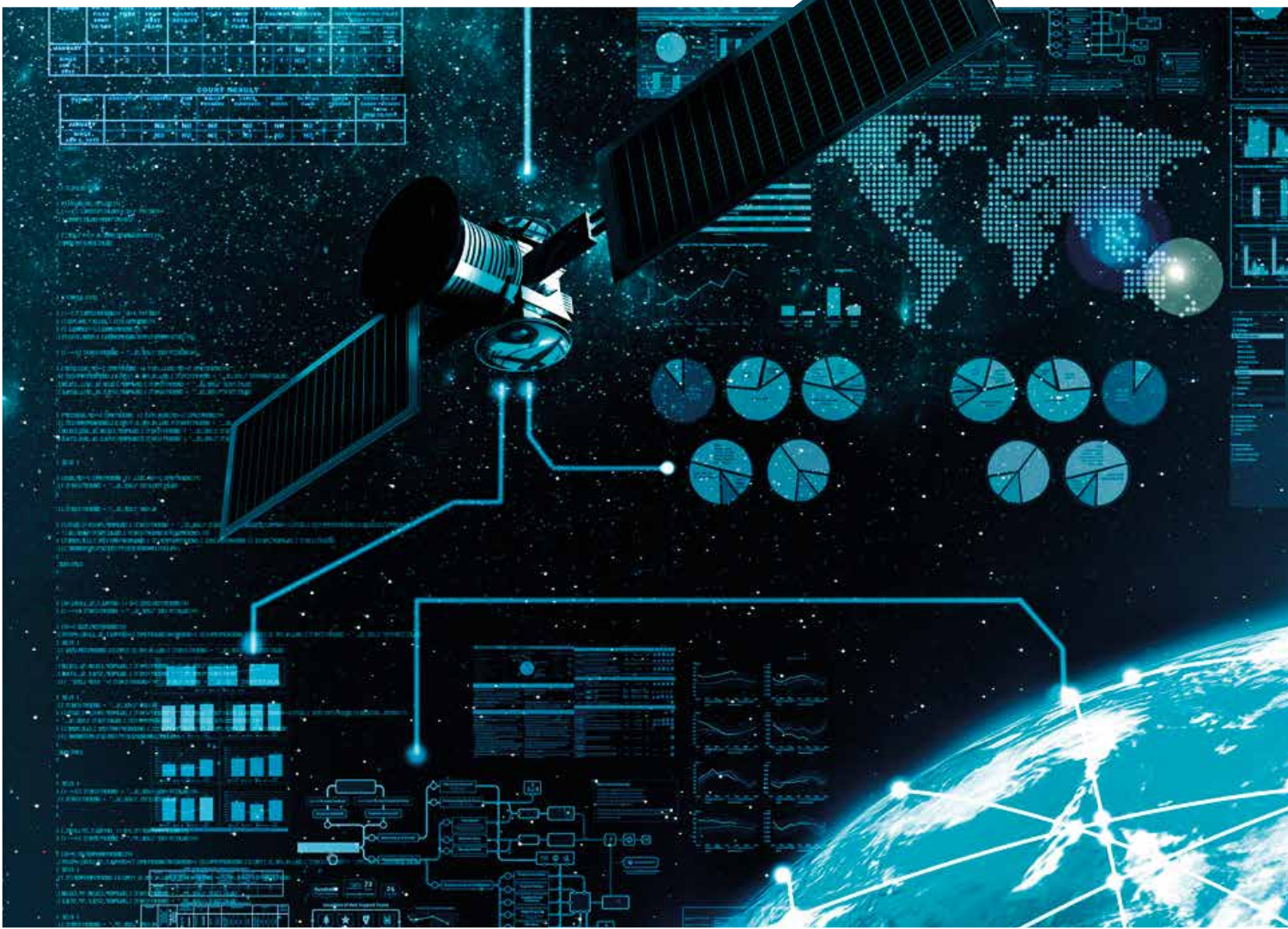
From June 21 to 23, the "World ATM Congress"—a benchmark aeronautical event in the national and international community on air traffic management—was held once more at the IFEMA Conference Center in Madrid.

GMV featured a stand where it presented its developments and applications in the field of navigation and surveillance,

including: **APRESTA**, a tool used for the automatic analysis of ADS-B performance and detection of GPS interference with ADS-B data; **Srx-10i**, dual-band GNSS jammer detector; **Emil**, ground inspection system for ILS and VOR radio aids; **MagicGEMINI**, GNSS system performance analysis tool; and **MagicIFP**, a web application for ground

and flight validation of PBN procedures based on satellite navigation.

The Civil Air Navigation Service Providers Organization (CANSO) and the Air Traffic Control Association (ATCA) collaborate in the organization of this event that attracts developers, experts, providers and other public with interests within the management sector of air traffic.



GMV cements its leadership in collision avoidance operations automation and coordination in Europe

GMV plays a decisive role in the three activities launched under the European Space Agency's CREAM (Collision Risk Estimation and Automated Mitigation), priming two of them

Space is getting congested and today, active collision avoidance has become a routine task in space operations, relying on validated, accurate and timely space surveillance data.

In this context, and as part of the Space Safety Program (S2P), The European Space Agency (ESA) defined in 2019 a technological cornerstone for Collision Risk Estimation and Automated Mitigation (CREAM).

The aim of the CREAM cornerstone is the development of technology for automated collision avoidance to reduce man-power efforts (experts on 24/7, extra efforts at ground stations), reduce the time between manoeuvre decision and close approach, and thereby reduce the number of false alerts, i.e. cases where control teams start an avoidance manoeuvre preparation which in the



end turns out to be unnecessary as updated data indicate a low collision probability. Optimised manoeuvre plans can be uploaded to the spacecraft and allow late decision taking, which is further enabled with activities for the development and testing of emergency command paths. With the launch of large constellations, conjunctions between operated spacecraft will occur more frequently. The cornerstone therefore also encompasses activities to coordinate manoeuvre planning.

The European Space Agency has started three activities in the framework of the CREAM program, in which GMV plays a key role as the main contractor in two of them.

The first one aims at the definition of “Automated avoidance manoeuvre decisions and design”. In the frame of this activity, a prototype software is to be implemented, tested, and

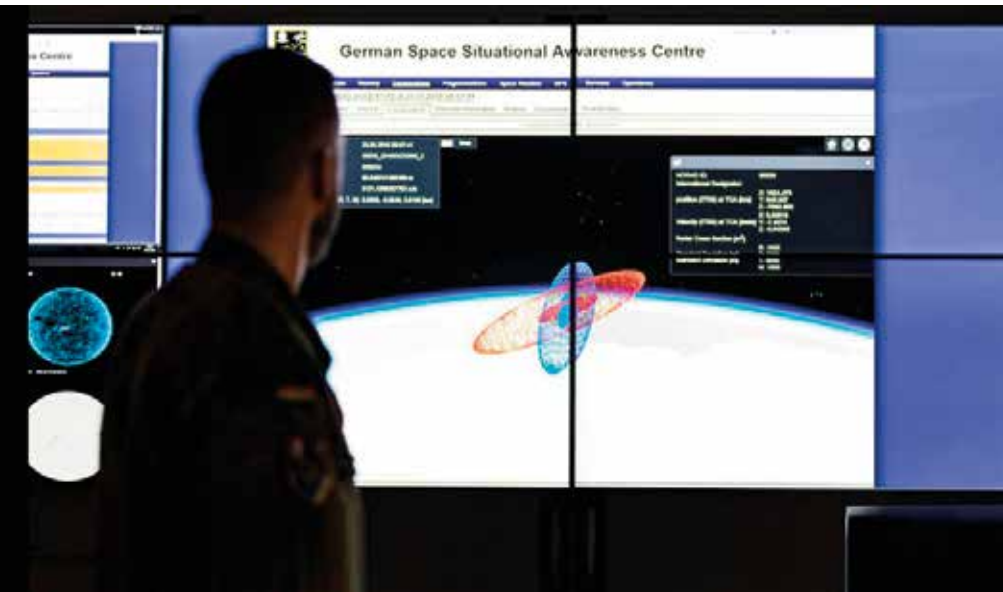
validated with historic conjunction data from existing collision avoidance processes. This software shall provide the means for autonomous decision making based on the use of machine learning and propose an optimum collision avoidance manoeuvre. GMV in Romania is leading this activity with a relevant involvement by GMV NSL in the UK and Neuraspace from Portugal. The development is based on GMV’s **autoca** autonomous collision avoidance system, developed for ESA in the frame of the ARTES program and finally accepted in March 2022.

The second activity is devoted to the “Development and Testing of Late Commanding Paths and Operations Concepts”. The aim of this activity is to develop and test concepts for late commanding paths which allow for late decisions in collision avoidance processes. Such a mechanism should be considered as part of the nominal

concept of collision avoidance operations as well as a tool for emergency response. Astroscale Ltd in the UK is leading this activity (see related press release from Astroscale here) with a very relevant support from GMV (from Portugal Romania and UK) and from OneWeb in the UK.

The third and final activity entitled “Means for coordination of operators and catalogue providers” will develop a coordination platform providing an information exchange architecture allowing for automated coordination and resolution of a prospected collision event between spacecraft operators and space object catalogue maintainers or collision avoidance service providers as well as a simulation environment for performance evaluation. GMV in Romania is leading this activity counting on UPB from Romania, Solenix from Switzerland and Iguassu from the Czech Republic as subcontractors.

GMV provides core software for German Armed Forces' SSA Center



■ The German Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw) has recently awarded a contract to Atos and OHB DC to supply the "Space Situational Awareness Center Expansion Stage 1" (Weltraumlagezentrum, WRLageZ, Ausbaustufe 1) to the German Federal Armed Forces. This system, located in Uedem, will enable the German Armed Forces to monitor

the situation in space and protect critical German infrastructure in orbit.

The system will be based on GMV's state-of-the-art COTS software for Space Surveillance and Tracking (SST) as the core processing infrastructure. This includes the most relevant SST capabilities and functionalities: object cataloging, sensor tasking, collision avoidance, re-entry prediction, fragmentation detection and

characterization, SST data simulation, SST data pre-processing, visualization, and more.

On top of GMV's software, OHB DC will add an operational layer, providing interoperability to the system. Additionally, Atos will integrate the various software and hardware components into the solution, creating interfaces with external sensors and ensuring the operational performance of the overall system.

With this new project, GMV strengthens its position as European industrial leader in Space Situational Awareness (SSA) and Space Surveillance and Tracking (SST). It also reinforces GMV's footprint in Germany, following the awarding of two relevant contracts in 2021 by the German Space Agency at DLR for the German Space Situational Awareness Center (GSSAC), also located in Uedem. The purpose of these contracts is to implement advanced SST data processing algorithms (BaSSTDa) for the development of the future EU SST catalog (under German responsibility) and for maintaining and upgrading the GSSAC Mission System (GMS).

GMV holds the EUSTM technical workshop

On May 12, after months of COVID restrictions, the EUSTM team was finally able to meet up for a technical workshop and discuss technology breakthroughs and progress made in the development of European STM capabilities.

The technical workshop was organized by GMV and SpaceTec Partners on GMV's Madrid site. Work-package leaders were invited to the workshop site while stakeholders and the rest of the team participated remotely. The workshop lasted for a full day with many interesting presentations and discussions from

the EUSTM partners, which later culminated in a team-building dinner.

Professionals from various organizations and the EUSTM consortium presented and discussed technology essential to developing future European STM.

Various organizations such as GMV, SDS, ADS, KRATOS, ClearSpace, D-Orbit, Astroscale, NorthStar, ONERA, FHR, LeoLabs, AIUB, ESA, 6ROADS, Numerica, OKAPI and, COMSPOC showcased their expertise and presented their work in pursuit of the European goal of developing STM capabilities. Commercial companies presented their work to make

space sustainable in such domains as in-orbit servicing, refueling and de-orbiting satellites.

Technical workshops like this play an important role in defining the future capabilities of a European STM as several stakeholders from the industry as well as the government participated in the workshop to swap notes on the best way of developing the potential of various technologies and the extent to which they might prove to be useful in the future. This in turn will allow the various stakeholders to converge on a specific approach and move forward with the goal of developing European STM capabilities.

Collision risk analysis and avoidance maneuver calculation software for EU SST users

■ GMV European industry leader in space surveillance – Space Situational Awareness (SSA) has been awarded a new contract by the Centre for the Development of Industrial Technology (CDTI) to develop software for advanced collision risk analysis and avoidance maneuver calculation for European satellite operators subscribed to the EU SST system's collision avoidance service.

The new software, called CONAN (CONJunction ANalysis Software), will have a dual purpose: first, to increase the capabilities and improve the response times of the S3TOC (Spanish Space Surveillance and Tracking Operations Centre) and secondly, to provide European satellite operators subscribed to the EU SST system's

collision avoidance service with their own conjunction analysis capability, as it will also be deployed in their control centers.

CONAN will receive messages containing conjunction data for each operator's satellites directly from the EU SST web portal for analysis. (The general purpose of this web portal is the provision of EU SST services.) It will also make it possible to analyze the collision risk calculation's sensitivity to uncertainties in the orbits of the objects involved. Finally, it will provide the optimal avoidance maneuver for high-risk cases, also analyzing the effect of the maneuver on other possible subsequent conjunctions with the same or other objects. It will also feature a panel for

monitoring statistics regarding the conjunction service.

In addition to the collision messages that the S3TOC and the French center (COO) publish on the EU SST web portal, CONAN will also be able to import messages issued by the equivalent American system (18-SDS, formerly known as JSpOC). This will allow operators to compare the information published by both sources in order to make the most appropriate decision in each case.

The CONAN software is a new development based largely on **Closeap**, GMV's solution for collision risk calculation, part of the **FocusSuite®** product line for flight dynamics operations, also used within the S3TOC.



The world's top space surveillance experts visit GMV's site

GMV hosted the 3rd Conference on Space Situational Awareness (ICSSA) organized by the International Academy of Astronautics (IAA) and the American Institute of Aeronautics and Astronautics (AIAA)



From April 4 to 6, renowned space surveillance experts came together at GMV's Tres Cantos site in Madrid to address a wide range of issues relating to the detection, identification, prediction, tracking, removal and disposal of space debris.

ICSSA, a 3-day conference and international marquee event, comprised

TESTIMONIALS

"The ICSSA was a valuable gathering of global experts focused on the technical issues related to space situational awareness (SSA). The collaborative environment prompted a variety of off-line discussions that epitomized the need for joint efforts that spanned measurement modalities, national borders, and stakeholder domains. I personally initiated five potential cooperative projects spanning strategic optical/radar studies, conjunction mapping database utility investigations, and collision hazard assessment methodology exchanges".
Darren McKnight. LeoLabs

"Excellent rendezvous of our little family, superbly organized by GMV! Great discussions over detailed SSA challenges, very enriching. IAA-ICSSA has now become a classic reference with a bright future ahead, unfortunately as long as we'll have such space traffic problems".
Christophe Bonnal. CNES

"The conference was really great, giving to the participants the opportunity to share their research with colleagues. I received several suggestions that will help me to improve my research!".
Antonio Prado. INPE

"ICSSA 2022 provided an enriching platform to present our research work to the SSA community. ICSSA gave a great opportunity to share and learn from innovative work by various research scholars from around the world. Many Thanks to the organising team of ICSSA 2022".
Shivshankar Sivaraman. Indian Institute of Science

"ICSSA 2022 gave us a wonderful opportunity to meet experts in space situational awareness from all over the world and learn about different ideas and initiatives to overcome the rapidly emerging problem of space debris. It



several panel-based sessions dealing with the general issues of orbit determination and prediction, cataloging and correlation, monitoring and sensor planning, assessment of collision and reentry risks, satellite control and evasion maneuvers, orbit proximity operations, elimination of space debris and data governance and policy. Present on these panels were representatives from space agencies and bodies as

important as the US Space Force, Europe's ESA, the Spanish Industrial Technology Development Center (CDTI in Spanish initials), France's space agency CNES, GB's UKSA, Romania's RoSA and Brazil's INPE, among others. Industry also weighed in with participation by LeoLabs, COMSPOC Corporation, Astroscale, OKAPI, TNO, Surrey Satellite Technology, among others, plus university researchers and

technology institutes from the five continents.

In keeping with its benchmark status in this area, GMV personnel offered five papers focusing on issues of the utmost interest such as object cataloging, the detection and estimation of satellite maneuvers, collision avoidance, sensor planning and onboard satellite space-debris detection systems.

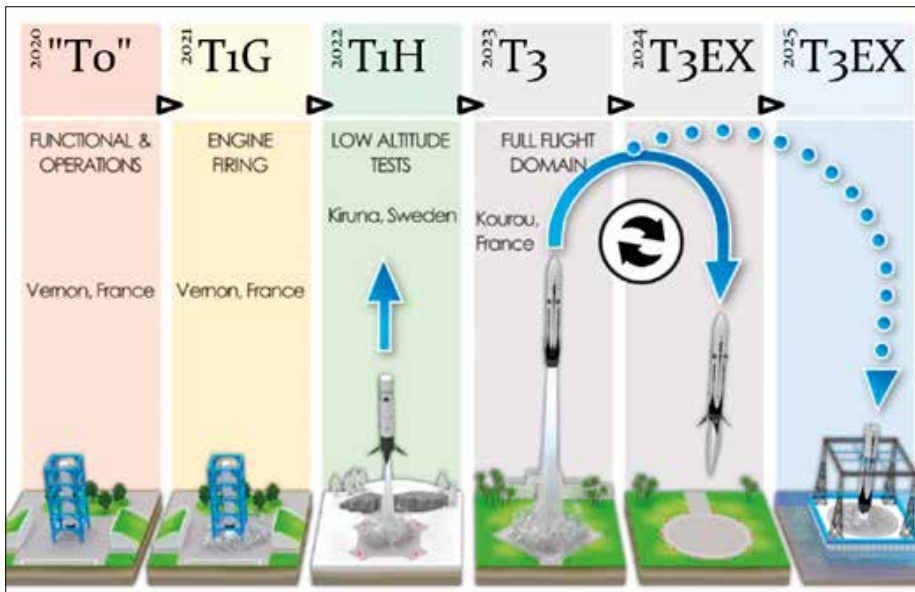
also provided a platform for us to share our innovative concept of mitigation of space debris from an Australian perspective with the use of a proposed network of mobile observatories. We hope to join the 4th conference and be part of this global initiative to make the space around Earth a safer place for our future generations". **Muhammad Akbar Hussain. Mareekh Dynamics**

"I think that ICSSA 2022 was a great success. There were many high-quality papers covering many SSA themes. It was nice to see many students and other young participants at the conference. Most of the student papers were very good. The conference organizers did a marvellous job, and we are all grateful to GMV for making their facilities available for the conference". **Prof. Arun Misra. McGill University**

"ICSSA 2022 was definitely a very interesting conference for all aspects related to SSA. Well organized in detail beyond any expectation, it was attended by several young people, ready and prepared to address the issues discussed during the event. Also noteworthy were the keynote lectures, which provided important information on the state of the art in various areas of SSA. Special thanks are due to the very excellent hospitality by GMV, and to Katie for her incomparable kindness and ability to coordinate all aspects of organization". **Carmen Pardini, Space Flight Dynamics Laboratory**

"After a long pandemic break, meeting leading experts in SSA in Madrid was awesome! For GMV it was a pleasure to host nearly 100 leading SSA experts from all round the world". **Alberto Águeda Maté. GMV**

Power Conditioning and Distribution Unit for launcher reusability



■ The European Space Agency has awarded GMV a contract for the design, manufacturing and qualification of a Power Conditioning and Distribution Unit (PCDU) EQM in order to demonstrate its readiness for integration on Themis TH1 prototype.

Themis reusable first stage demonstrator is considered as a flying test-bench opportunity to demonstrate some of key enabling and promising capabilities within the Future Space Transportation technologies maturation roadmap for lowering the cost of access to space, for increasing Europe's flexibility to

offer a variety of launch services and for contributing to a more eco-responsible space launcher sector.

The Themis PCDU will follow Themis prototype in its incremental logic. A Modular Power Unit (MPU) is foreseen to be integrated in Themis T3 (Themis 3-engine flight test) reusable first stage demonstrator. The MPU concept will push towards a modular power architecture of the avionics functional chains, allowing the integration of avionics Components-Off-The-Shelf with different power characteristics, to lower the recurring costs of future European launchers. In the frame of

this activity, GMV has been asked to put in place all necessary steps to reach a first important milestone towards the final MPU, the Themis PCDU. The Themis PCDU will be designed with the objective to be integrated in Themis T1H (Themis 1-engine Hop test) hop-tests.

This new PCDU will present as main functions the possibility of distributing power to relevant equipment with independent buses, providing housekeeping monitoring's (voltage, current, temperature).

Several features are derived from the main functionalities, such as: Activation and turn on/off the equipment; control inductive loads like solenoid valves, using PWM control; regulate equipment voltages; ensure current limitation; safety: no failure propagation and high voltage interlock; modular, configurable, and affordable to be able to be integrated on a demonstrator which is incrementally developed.

Design phase will be followed by unit manufacturing and a test campaign to verify the functional performance of the unit, as well as an environmental verification to guarantee Themis PCDU hardening towards Themis environment.

GMV shares its space-data system expertise at DASIA

In mid May GMV took part in the latest international conference on space systems engineering, DASIA (Data Systems In Aerospace).

DASIA is a yearly conference that has been held by Eurospace since 1996. Its remit is to bring together space data systems specialists for 3 days of networking. DASIA 2022 was held online; GMV representatives presented

two papers together with other sector professionals: The two papers presented by GMV dealt with "Artificial Intelligence Techniques in Onboard Avionics and Software" and "In-Orbit Space-Based Surveillance System by high-performance computer-vision algorithms and dedicated HW avionics".

DASIA addresses technical and managerial aspects of the development,

operation and maintenance of data processing components for space and aeronautical command and control applications, as well as other sectors that share the same features of great reliability and complexity. GMV is delighted to take part in this event that attracts top-level participation from the space industry, universities, space agencies and institutions.

ESA awards GMV the development of CHIME's end-to-end mission performance simulator

■ GMV is leading the development of the end-to-end mission performance simulator for CHIME, the Copernicus Hyperspectral Imaging Mission for the Environment, one of the six candidate missions in the frame of the Copernicus Space Component Expansion program. CHIME is currently undergoing industrial Phase B2, and its goal is to provide routine observations of land and coastal areas for the management of natural resources through the use of hyperspectral imagery. This will enable new services for agricultural and biodiversity applications, as well as the characterization of soil properties.

The contract has been awarded to GMV as the Prime of a Consortium completed by the University of Valencia, Helmholtz-Centre Potsdam German Research Centre for Geoscience (GFZ) and the National Institute for Environmental Protection and Research (ISPRA). GMV is responsible for coordination of the activities, technical specifications,

concept design and definition of interfaces for the end-to-end simulator, implementation of the simplified Observation Performance Simulator and Performance Assessment modules, complete integration and verification of the end-to-end simulator, as well as the execution of the scientific validation and performance assessment campaigns in order to verify that the objectives of the CHIME mission are met.

End-to-end mission performance simulators for Earth observation missions are a useful tool to assess the mission performance and support the consolidation of the technical requirements and conceptual design, as well as to allow end-users to assess fulfilment of mission requirements. The development of these end-to-end simulators starts during the mission feasibility studies, so that if the mission is approved, the simulator will evolve into a support tool for the detailed design definition, preparation and validation



of operations, data processing and higher-level mission products generation.

GMV is working on a standard for post useful-life satellite capture and deorbiting

■ MICE Qualification Kick-Off Meeting was successfully held on March 23. The activity is a follow-up of previous MICE activity, concerning the design, manufacturing and test of the passive mechanical interface to be embedded on future Earth Observation satellites. This interface is one of the technical solutions identified in the frame of ESA Clean Space initiatives to enable the capture and later de-orbiting of Earth Observation satellites at the end of their operational life.

With this heritage, an update of the design is expected in the present activity, as well as the manufacturing and testing of the updated Passive Interface (PIF) in order to achieve its qualification. GMV leads the project, relying on AVS (Added Value Solutions) as main subcontractor for mechanical design and manufacturing aspects. First customers for the qualified MICE are expected to be all the Copernicus Sentinel Expansion missions, to be

launched in the next years. MICE is intended to become in the next years a standard interface for the End Of Life disposal of Low Earth Orbit satellites.

In parallel, GMV is already working in the design, prototyping, and testing up to TRL4 of the Servicer satellite technologies required to rendezvous, capture and de-orbit the client satellites equipped with MICE interfaces.

GMV strengthens its position in novel satellite communications concepts



■ Upcoming Earth Observation (EO) missions will require very high downlink data rates (in the order of Gbs) over less reliable links (K-band and optical). In the last few years GMV has built key capabilities in its German branch by priming several complementary projects, consolidated recently with new contracts for the ESOC (The European Space Operations Centre of the European Space Agency)'s ground stations engineering division. The experience gained puts GMV at the forefront of European capabilities in this domain, allowing GMV to undertake all aspects across the board, from engineering studies to operational deployments.

The "Delay Tolerant Networks for flexible communication with EO satellites" study

was initiated in 2017 to research the performance of DTN in future EO and constellation-type missions. DTN was shown to provide efficient data transmission in all scenarios, although some design decisions were discovered in the NASA's ION DTN implementation.

The "E2E assessment of protocol stack for EO use cases" study provided a thorough analysis of current and future space-to-ground communication infrastructure and its applicability to future Copernicus missions, including features like K-Band & Optical physical layers, network-centric, node-rich, and distributed architecture, application-layer protocols, relay services (EDRS and commercial).

The "High throughput Optical Network Simulator Testbed" activity for ESA/TAS-I started in 2021 with contributions from GMV's German and Polish teams. It will design a testbed to conduct protocol evaluation and technology demonstration considering various network and implementation options (for both space and ground segments), different type of external user interfaces and user traffic.

ESA/ESOC's "Optimised CCSDS Protocol Stack for High-Rate Earth Observation Downlink Scenarios" project started in early 2022 to analyze present and future protocol stacks. Based on previous activities it will focus on consolidating the potential protocols into a generic protocol stack suitable for high-rate applications.

Finally, ESA/ESOC kicked-off the "Distributed CFDP" project in April 2022. Due to limitations in available terrestrial bandwidth, it will not be possible to forward CFDP protocol information from the ground station in real-time to close the CFDP protocol at a central location; for this reason, a specific distributed CFDP approach has been adopted. A combined team of Darmstadt and Munich personnel will implement the system to be used operationally in future Copernicus missions.

2nd Space Law Congress

In late April GMV took part in the Space Law Congress (*Congreso Jurídico Espacial*), held under the title "The need of regulation in Spain's space sector", was organized by the Space Committee of Spain's Engineering Institute and the Aerospace Legal Observatory (*Observatorio Jurídico Aeroespacial*), formed by the Spanish Association of Aeronautics and Space Law (Asociación Española de Derecho Aeronáutico y Espacial: AEDAE) and

the GIESA BIOLAW Research Group of the Law School of the Universidad Complutense de Madrid.

The congress brought together representatives from the aerospace industry and government authorities, who took part in five panels debating various issues.

Jorge Potti, General Manager of GMV's Aerospace sector and vice president of

TEDAE's Space Committee, participated in two discussion panels. The first, dealing with institutional matters, included representatives from INTA, EUSPA, CTA and the National Security Department of the Government Presidency. It ran through the process of setting up the Spanish Space Agency. Potti also took part in the panel debating "Legal Needs", which looked at the main questions to be regulated in Spain's future space activities law.

GMV helps to set up a high-speed optical transport network in space

■ GMV is responsible for the design and implementation of the HW/SW simulator and emulator in the frame of the European Space Agency's HyDRON project.

HyDRON (High Throughput Optical Network) forms part of ESA's ScyLight program for the development of secure laser communication technology. The project vision is 'Fibre in the Sky' or 'Internet beyond Clouds' technology integrated in terrestrial networks to support the next generation of missions that require advanced communications capabilities. The increasing use of space by both institutions and commercial markets has led to the need for a high data rate Optical Transport Network in space.

GMV is supporting various activities from Germany and Poland in the early

stages of this project. Our teams are working in parallel on the HyDRON Demonstration System (DS), known as HyDEMO, and the HyDRON Simulator Testbed, known as HySIMULED.

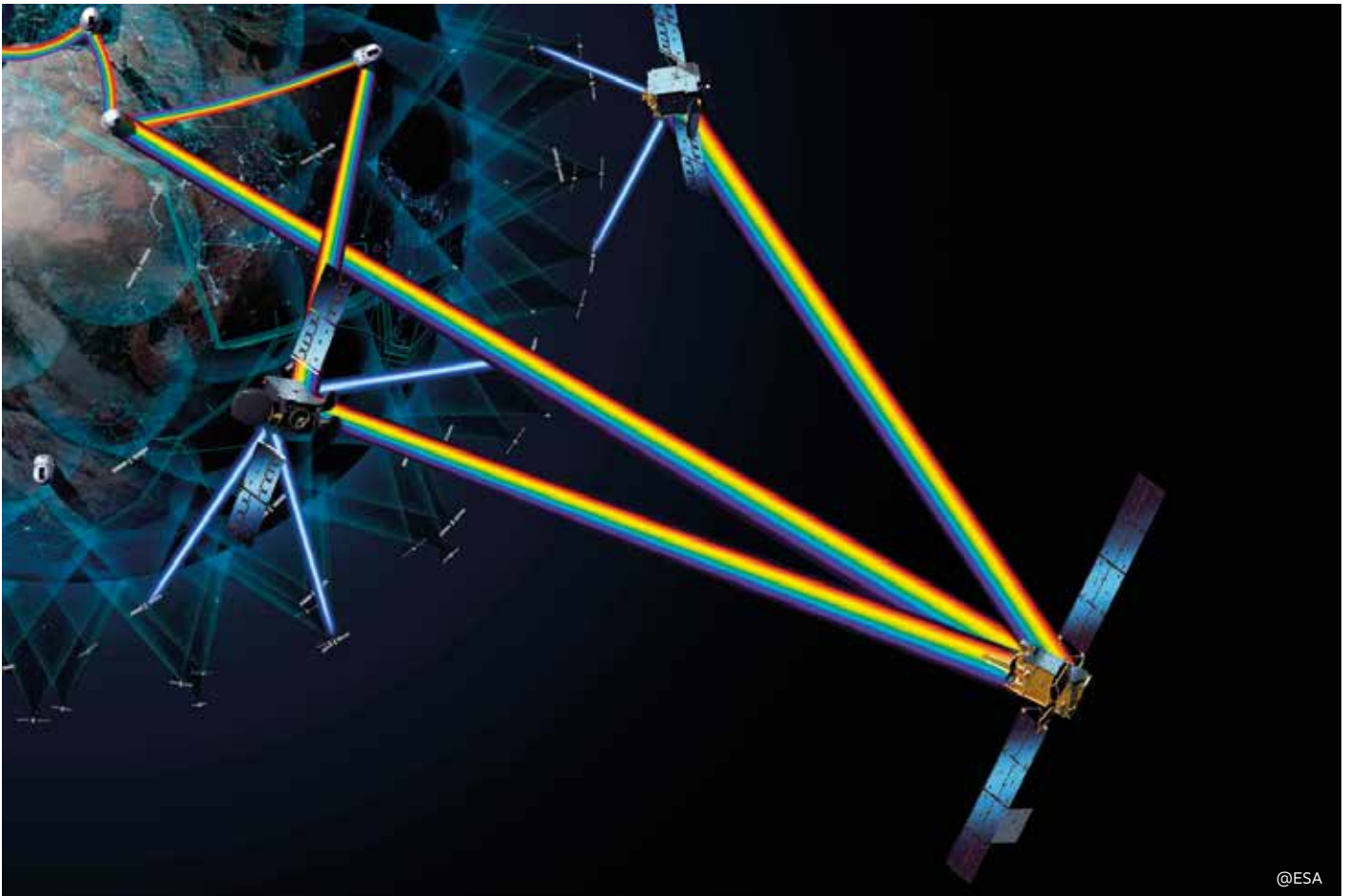
HyDEMO aims to drive the HyDRON vision by enabling the development and validation of 'Fibre in the Sky'. HyDEMO sets out to build a high-throughput, multi-node optical network in space and on the ground to provide high-capacity data transmission services and flexible network services across the globe - with an estimated launch date of 2027.

GMV's team in Germany is focusing on creating and developing the initial Concept of Operations for HyDEMO, together with GMV in Poland and various partners.

The objective of HySIMULED is to design, develop and assess a Testbed for verification and evaluation in the HyDRON end-to-end system, considering network designs and implementation options (for both space and ground segments), different types of external user interfaces and user traffic.

The HyDRON Simulator Testbed will be used as a tool to consolidate the HyDRON Mission concept, system functionalities and end-to-end system architecture design. The tool will support the definition of the HyDRON Demonstration System concept, consolidation of technical trade-offs, baseline selection and performance specification at lower levels.

In addition to these activities, GMV also provides consultancy for the overall system.



@ESA

GMV in the successful EnMAP satellite mission

■ GMV in Germany was part of the successful preparation and execution of the Launch and Early Operations Phase (LEOP) of the DLR (Deutsches Zentrum für Luft- und Raumfahrt) hyperspectral satellite mission EnMAP (Environmental Mapping and Analysis Program). EnMAP is supported by the Federal Ministry of Economy Affairs and

Climate Action based on a decision by the German Bundestag.

It was launched on the first of April at 16:24:14UTC with SpaceX's Falcon 9 from Florida. The weather did not seem very friendly on the previous day, the launch probability dropped to 30%. Luckily, on the day of the launch, the weather improved

and EnMAP could start its mission as scheduled.

EnMAP mission's objectives are the measuring and modelling of Earth's ecosystem dynamic geochemical, biochemical, and biophysical processes and so allowing to evaluate the status quo and evolution of various terrestrial and aquatic ecosystems.



GMV Works on the ESA's Cosmic Kiss Mission

■ After nearly six months of operations, Cosmic Kiss culminated in European Space Agency astronaut Matthias Maurer's first mission to the International Space Station (ISS) on May 6.

Bolstered by GMV's support from the Columbus Control Center (Col-CC) in Oberpfaffenhofen, Germany, the mission

has allowed more than 35 European experiments to take place in addition to many more international ones.

GMV was particularly present on both the mission's flight control team (FCT) and the ground control team (GCT), helping ensure the mission completed its demanding goals.

Although the Cosmic Kiss mission may be over, that doesn't mean the work is done. In fact, Col-CC teams are already thinking about the ESA's next mission to the ISS—the Minerva mission—Samantha Cristoforetti's second mission to the ISS, one in which GMV will also play a vital role.

GMV's correction service products to be used for the PAZ mission

This represents a new feather in the cap of GMV's correction service, providing quasi real time products for the METOP and Sentinel missions

G MV has recently reached an agreement with Hisdesat for becoming the provider of precise GNSS near real-time products, to be used within the Orbit Determination process of the PAZ satellite.

The PAZ satellite, launched on 22 February 2018, is owned and operated by Hisdesat and is based on the use of a high-resolution X-band Synthetic Aperture Radar (SAR). The satellite orbits the Earth in a LEO

polar orbit of 514 km altitude, and its mission supports a wide number of applications, including Environmental monitoring, Protection of natural resources, Surface monitoring, City and infrastructure planning, Monitoring of natural catastrophes and high-resolution mapping, among others.

This agreement means a new achievement for GMV's Correction Service, as it already provides near-real-time products for other LEO missions, namely, the METOP and

Sentinel. GMV's Correction Service has a relatively short commercial history, as it was first launched back in 2018. However, over the last 4 years, it has not only become the GNSS products' provider for the 3 aforementioned LEO missions, but also the Real-Time Precise Point Positioning (PPP) corrections provider for companies operating in different markets, such as GNSS receivers manufacturing, Automotive, Offshore Survey & Construction, and Maritime, among others.



GMV provides Earth Observation-based services for the energy sector

■ GMV's subsidiary in the U.K., GMV NSL, has been awarded the ESA co-funded activity named "SMARTGRIDS-DEMO", which is supported by ESA Space Solutions through ESA ARTES BASS (Business Applications Space Solutions) Programme. It is a demonstration project, which builds on the outcome of the previous feasibility project, successfully completed in 2020.

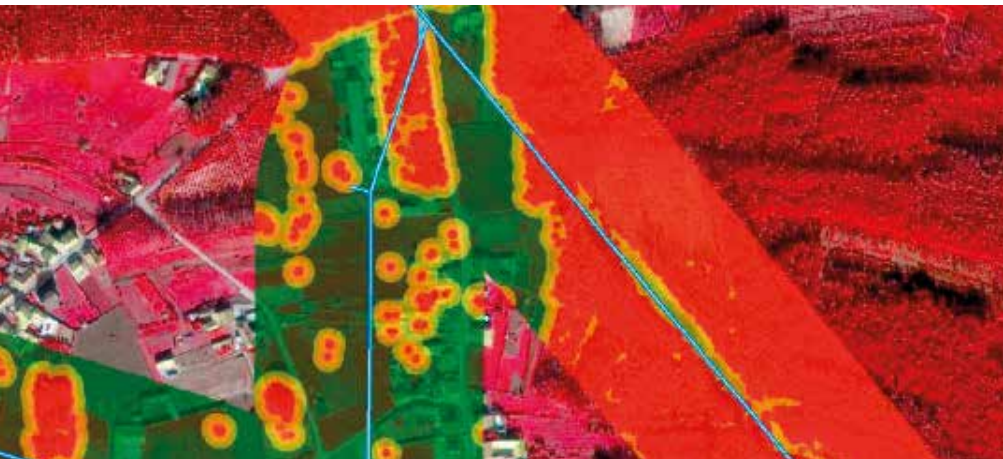
The SMARTGRIDS-DEMO project aims to develop technically and financially feasible services that can assist energy-network stakeholders in their work practices. Earth Observation data, including satellite

imagery, and artificial intelligence techniques, will be the key assets in the development of services that can help improve performance, reduce costs, and mitigate any problems that might arise from the management, maintenance, and operation of the energy-network infrastructure.

GMV is developing this with the cooperation of ENTSO-E (European Network of Transmission System Operators for Electricity) and nine Transmission System Operators across Europe that are actively involved in the pilot demonstration of three main services:

- Vegetation Management service, to support silvicultural activities and help users prevent vegetation encroachment in the rights of way (the land corridors immediately below and adjacent to the transmission towers and lines). The figure below shows an example of one of the products under development, i.e., a map showing the vegetation height in the corridors.
- Change Detection service, to identify human-induced events in the proximity of the network infrastructures.
- Disaster Management service, to provide fast analyses of Very High-Resolution imagery, with identification of any damage over a given location in response to a user's request, triggered by disaster events.

The project kicked off at the beginning of February. After refining the requirements through conversations with the users, the team is now developing the machine learning models.



MED-GOLD presents its findings

■ At the end of March, an event was held to present the findings of the European research project MED-GOLD. The event was aimed at interested members of the public as well as policy, industry, academia, and research stakeholders from sectors such as agriculture, energy, and communication.

Four years of research went into the project in order to create tools to foster food systems that are more resilient to climate change and, therefore, more competitive and efficient. GMV is responsible for the work package dealing

with the communication, exploitation and dissemination of MED-GOLD's value chain; as such it is leading the project's climate-service marketing and communication activities.

The planet has been witnessing the consequences of accelerated climate change for years. The agriculture sector in particular is one of the most sensitive to altered climate patterns and their associated ecological, economic, and social impacts. The European project has focused on three of the flagship agri-food sectors in the Mediterranean:

grapes/wine, olives/oil, and durum wheat/pasta.

During the recent MED-GOLD public meeting, the findings of the three studies were presented to producers, consumers, and policy-makers, providing evidence on climate challenges. In the framework of MED-GOLD, pilot services have also been developed and applied in real environments.

MED-GOLD is part of the European Union's Horizon 2020 framework program for research and innovation, under funding agreement number 776467.

Earth observation for the design, planning and management of green urban infrastructure

GMV is leading the Space 4 Urban Green (S4UG) project, brokered by the European Space Agency. Its aim is to demonstrate the technical and commercial feasibility of EO-based services for integration of green infrastructure in urban planning

Increasing importance is given nowadays to a good development and management of green areas in urban environments, taking into account their impact on environmental factors and implicitly on inhabitants' wellbeing.

In recent year, several initiatives at all levels from global to local have been focusing on promoting a good integration of green infrastructure in urban planning. There are several initiatives that are being promoted by EU agencies, such as EU Strategy on Adaptation to Climate Change 2021, EU Biodiversity Strategy 2030 'Bringing nature back into our lives', or the European Green Deal. Beyond EU policy; national and regional governments focus on providing a supportive framework for urban adaptation. A major drawback identified during these programs was the absence of common data-collection and -sharing methods that are easily scalable.

A viable solution for supporting actions of this type is space-based data, which is widely available, ensuring a spatial and temporal resolution in keeping with the current requirements of key urban-planning and decision-making stakeholders.

In this context, The European Space Agency has launched the Space 4 Urban Green (S4UG) feasibility study, a

nine-month project funded by the European Spatial Agency through the ESA Express Procurement Plus – EXPRO+ programme.

The objective of S4UG is to demonstrate the technical and commercial viability of EO-based services addressing actions such as design, planning and management of urban green infrastructure by making the space-based data and products more accessible to targeted beneficiaries.

The services envisioned by S4UG should provide affordable planning

and monitoring support based on EO, in situ data and AI techniques for authorities involved in urban management.

The proposed consortium for the project pools complementary skills within urban EO data analytics, processing paradigms, environmental and socio-economic aspects, all merged by combining the expertise of relevant partners and stakeholders: GMV as prime contractor, CEOSPACE TECH with experience in developing tools and solutions based on Earth Observation and CARTIF as 3rd party contributor.



Living Planet Symposium 2022

■ Held from 23 to 27 May in Bonn (Germany), ESA's Living Planet Symposium once again brought together scientists and researchers as well as industry representatives and EO data users from around the world to present and debate the latest earth science discoveries and the way in which satellite data supports research and climate-change combating action.

GMV is working busily in the market of earth observation applications, adding value to satellite images. It therefore featured prominently in this symposium with over 20 contributions, including poster sessions, oral presentations and forums.

As well as sponsoring the symposium, GMV also ran a stand showcasing its activities within various programs of Europe's Copernicus earth observation program and systems developed for processing earth observation data.



Ennoforum 2022

On 20 and 21 April GMV was present at Ennoforum 2022, a biennial wine forum, showcasing the latest technological breakthroughs and bringing together producers, technicians, enologists, agronomists, researchers and technology providers.

Together with the winery Bodegas Pago de Carraovejas (PDC), GMV explained the work carried out on its

vineyards using its **Wineo** services for the digital transformation of the farming sector, in particular for wine harvest yield forecasting with machine learning applied to satellite images.

Precise and early estimation of the wine yield makes it easier to make crucial decisions both in the vineyard itself and the winery; it is also

crucial for defining vintage quality. Previously, PDC's fieldwork was tremendously cumbersome and time consuming; not only the number of grape bunches per vine were counted but also the number of grapes per bunch and the grape weight. The machine learning model developed by GMV for PDC has streamlined all this work and made it much easier to forecast the winery yield.

EO4SD wrap up event

On 27 April the European Space Agency (ESA) and the World Bank put on the EO4SD wrap up event: climate resilience to show the use cases and lessons learned in the climate resilience component of the in the earth observation for sustainable development (EO4SD) initiative.

The Climate Resilience project, carried out by a GMV-led consortium, has generated a series of use cases in liaison with key actors of the Development Banks, providing these banks with geospatial information to help them make better decisions to boost the climate resilience of the public in general and in particular the sectors most prone and

vulnerable to the adverse effects of climate change.

As well as presenting several successful EO4SD use cases, the event also laid down the roadmap for the next phases of the initiative and in particular in terms of its main component, the Global Development Assistance program.

CYBELE draws to its end

■ In March, after three busy years, the CYBELE project (fostering precision agriculture and livestock farming through secure access to large-scale HPC-enabled virtual industrial experimentation environment empowering scalable big data analytics) came to an end.

Coordinated by the Waterford Institute of Technology (WIT) and involving 31 international partners, the 14-million-euro CYBELE project was financed under Horizon 2020 (H2020), the EU's Framework Programme for Research and Innovation.

Under this project GMV led one of the nine pilots to assess and demonstrate the use of these technologies as applied to precision arable farming and livestock farming, focusing on the development of climate services as decision-making support systems for orchard management.

The review meeting, held on 19 May, was attended by project partners and European Commission representatives.

CYBELE has shown that the convergence of HPC, Big Data analysis, cloud computing and IoT could revolutionize agriculture, boosting foodstuff supply and reducing

food scarcity, generating social, economic and environmental benefits.

The CYBELE platform as developed in this project has given the various stakeholders unmediated, integrated access to a vast store of large-scale datasets of diverse types from various sources, doing so in such a way as to generate value and extract useful insights. The idea is to afford secure access to large-scale HPC infrastructure that supports data discovery, processing, combination and visualization services, solving modeling challenges that call for a high computing power.



The future of storage and distribution lies in robotics and artificial intelligence

Digitalization and automation are sine qua nons in warehousing and delivery services, to meet the current problems in the supply chain and the challenges of, outsourcing, the rise in raw material and fuel costs, while also fulfilling the goal of converging in a model of sustainable development. Moreover, e-commerce is still growing and making inroads in shopping habits. Warehouses and distribution networks now therefore need to up their game and they are increasingly turning to robots and artificial intelligence to meet the needs of the present and future market.

Ángel C. Lázaro, head of industry robotics and automation of GMV's Secure e-Solutions sector, took part in representation of HispaRob in the MotorTec debating panel on digitalization and automation of warehouses and the delivery service in the aftersales sector. The debate took stock of the Spanish market in terms of technological opportunities, the main challenges faced by firms, useful tips and delved into the technologies to be taken into account when initiating a storage and distribution digitalization process.

As an example, Ángel cited the developments underway with mobile robotics for last-mile deliveries and the AgrarIA project, which aims, among other things, to optimize space, product layout and warehouse loading and unloading procedures.



The Robotic Digital Twin projects comes through its critical design review with flying colors

The purpose of this milestone event is to approve the detailed design document and state of the software under development and review the general state of this project, which pools cutting-edge technology of virtual reality, artificial intelligence, simulators and control centers

In April the critical design review (CDR) was held of Robotic Digital Twin (RDTWIN). RDTWIN is a European Space Agency project being carried out by a consortium including GMV to develop the digital twinning concept in a demonstrator.

The digital twinning concept was first applied in the noughties in an industrial environment and thence extended to other areas. The idea of this project is to create a synthetic environment that is faithfully reproduced by the robot, its environment and the interactions between both.

This will involve the creation of a system model represented by a set of variables whose evolution is determined by the model and whose design is different from that of a simulator. Whereas, in a simulator, there are physical changes in the real model that do not necessarily produce a change in the simulator model, in a digital twin, any change in the physical model leads directly to a change in the state of the digital model, and vice versa.

Under this project, led by Trasys International and also involving the Fondazione Bruno Kessler (FBD), GMV's

input will be onboard science plus extension and adaptation of the mission control center EGOS CC.

This boils down to all the following: an analysis of the state of the art, the carrying out of use cases, architecture design, development and adaptation of a case for the science detector, development of extensions to the mission control center EGOS-CC to support the needs of the Robotic Digital Twin and participation in the implementation plan.

The remit of the critical design review (CDR) was to approve the detailed design document and the state of the software under development. The review also took stock of the general state of the project so far: actions carried out in this first phase, actions still pending, risks and the final definition of testing scenarios.

The project, which pools the most groundbreaking technology of virtual reality, artificial intelligence, simulators and control centers, is being carried out with an agile methodology that is planned to include a series of iterations or successive sprints.

The project kicked off in late 2021 and is now in the coding and development phase.

GMV technology for future moon-exploration missions



■ GMV is leading a European consortium to carry out the preliminary design and development of a prototype for future moon missions.

This project, European Moon Rover System (EMRS) Pre-Phase A, consists of the design of a moon rover that can be adapted to suit the various moon missions to be launched in coming years, focusing on three main missions: Polar Explorer, ISRU Pilot Plant and ALO.

Polar Explorer consists of a rover to the moon's south pole to carry out

reconnaissance and ground mapping tasks. For this purpose the rover has to be capable of visiting 10 waypoints, with a total run of 25 km. To achieve a run of this distance the rover must be quicker and lighter than current designs, using a groundbreaking propulsion system.

ISRU Pilot Plant calls for a rover capable of loading over 200 kg of regolith, with an excavation capability too. This requires a strong traction and loading capacity, whilst freeing the plant-connected rover from external energy needs.

Lastly, the ALO mission seeks to deploy an astronomical observatory on the dark side of the moon. In this case the rover has to be capable of transporting and unfolding antennae after reaching the deployment zone, so it combines the range and loading capacities of previous missions.

GMV, drawing on the space robotics projects LUCID, RAPID and CISRU, proposes a modular rover design and egress system that allows small tweaks to suit the requirements of each mission as well as other future non-polar geological missions.

Burgos once more the hub of educational robotics

A total of 1,500 people came together on 7 May to witness the final of the 6th ASTI Robotics Challenge, organized by Fundación Asti in Burgos's Museum of Human Evolution (Museo de la Evolución Humana).

GMV has sponsored this competition, the main purpose of which is to nurture budding STEM talent and empower the future generation of leaders in the field of collaborative mobile robotics.

This year's challenge kicked off in September 2021. As in former years it was divided into two categories: firstly 10th grade, baccalaureate and pre-baccalaureate vocational-training pupils, and, secondly, university undergraduates and post-baccalaureate vocational-training pupils.

After a knock-out online semifinal held in March with 103 teams from 26 autonomous community

centers, 35 teams then went on to the final.

Mariella Graziano, GMV's executive manager of commercial development and strategy of flight systems and space robotics, once more sat on the jury to judge the work of participating teams, both in the design and construction of a mobile robot and performance in the various competition tests.

The new role of robotics, a step forward into the future of automation and sustainability

The coronavirus pandemic has set unprecedented challenges for many of Spain's productive sectors. One of the hardest hit by mobility constraints, workplace shutouts and component shortages is the manufacturing industry. Notwithstanding this, the prospects for coming years are bright, buoyed up by technological innovation and investments under Spain's Resilience, Transformation and Recovery Plan (*Plan de Recuperación, Transformación y Resiliencia*: PRTR).

Here is where robotics, and, where applicable, collaborative robots, really come into their own, not only in terms of improving and streamlining production but also increasing worker

safety, due to the high contagion risk in closed environments. Cobots have greatly helped to democratize SME technology takeup, debunking the hackneyed idea that such technology is profitable only for multinational carmakers or the big firms. SMEs have opted for cobots for several reasons, the most important being:

- The acquisition and commissioning costs are much lower than with conventional industrial robots.
- Programming is much simpler and more intuitive.
- The plant footprint is greatly reduced since there is no longer a need to fence it off or install proximity sensors.
- Inertial sensors are capable of predicting a collision with any person and shutting down before causing harm.
- Greater flexibility in moving around the plant and fitting in with the different workloads.

Although the abovementioned factors are deal clinchers when purchasing equipment of this type, perhaps even of greater importance is the ease of integrating cobots with AI systems, enabling the robot's movements to be tweaked in line with dynamic situations as they crop up throughout the day, as they do in any production process. The latest developments in parallel computing technology, both

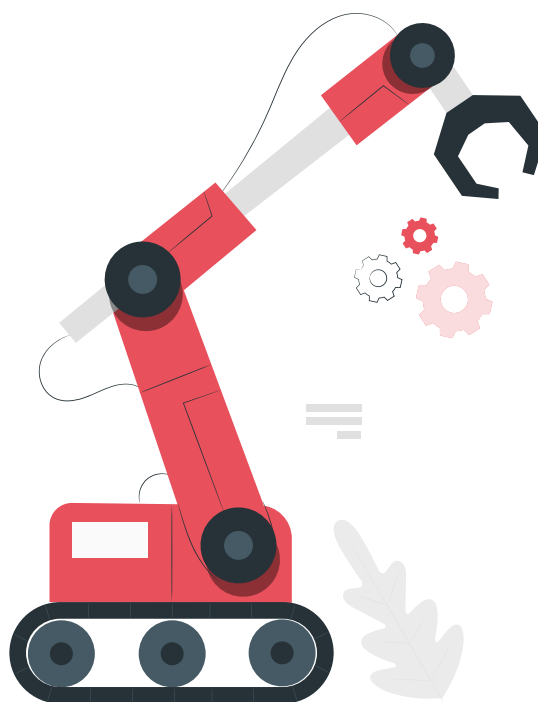


Ángel C. Lázaro
Head of Robotics and Automation of the Industry Sector
GMV's Secure e-Solutions sector

"Head of Robotics and Automation of the Industry Sector of GMV's Secure e-Solutions sector "

onsite and cloud, taken together with the development of new algorithms and AI strategies, have also opened up new possibilities. We at GMV are now carrying out projects to integrate both technologies in sectors as diverse as the following: the chemical industry, for handling samples and waste; farming, for versatile fruit packing of different grades and sizes; or software development itself, for mobile app battery testing.

Finally, it should certainly be noted that the takeup of robotics favors SDG fulfillment, steering industry towards a new, development-driving but ecofriendly digital model that also gives greater protection to the environment.





GMV firms up its position as a tried and tested supplier of the European External Action Service

GMV signs a three-year framework agreement with EEAS for the provision of geographic information services



G MV has recently signed a three-year contract with the European External Action Service (EEAS) plus its first specific 2022 contract for provision of geographic information services to be rolled out and used in classified systems. The project includes development of a tactical viewfinder capable of providing geographic information services for EEAS's various user communities.

The system will be rolled out on EEAS's new secure infrastructure for handling classified information with the aim of affording a Shared Operational Picture, based on a

standard-compliant information exchange. This system boosts situational awareness and the decision-making capacity of those in charge of the mission.

The next step is the signing of a new specific contract to run from December 2022 to December 2024, for the carrying out of activities to guarantee level of service, maintenance, training, consultancy and participation of the system in the various armed forces.

EEAS is redefining and reinforcing its structures and capabilities in order to enable the EU to react more quickly,

efficiently and effectively as provider of security services outside its boundaries. These operations cover the whole spectrum of crisis-prevention, -response and -management, taking in humanitarian aid, civil protection, support for stabilization and restructuring of conflict zones and evacuation of European citizens.

GMV's wealth of experience in communication and information systems (CIS) for command and control enables it to take charge of the whole range of activities, confirming the establishment of a long-term cooperation framework as a go-to supplier of EEAS.

The iMUGS consortium demonstrates the swarming capability of unmanned systems



■ On 2 June Belgium hosted the 4th of the programmed six demonstrations under iMUGS (Integrated Modular Unmanned Ground System).

iMUGS, part of the European Commission's European Defence Industrial Development Programme (EDIDP), is being carried out by a consortium led by Milrem Robotics together with 11 hi-tech defense firms, including GMV.

GMV is coordinating the command, control and interoperability subproject

C4ISR. GMV is bringing to the table its experience in ground C2 systems and JISR (Joint Intelligence, Surveillance and Reconnaissance) interoperability, for the purpose of developing the tactical C2ISR component, which will cater for planning and carrying out manned-unmanned teaming (MUT) operations and mining and distributing the unmanned ground vehicle's sensor data.

GMV's participation in the iMUGS project is based on its past experience in ground C2 systems, C2 systems for dismounted soldiers and JISR

interoperability, areas where GMV is one of the leading companies in Europe. GMV is a longstanding supplier of artillery and dismounted-soldier command and control systems for the Spanish MoD. Since 2016 it has been responsible for maintenance and upgrading of the EUCCIS C2 system of the European External Action Service (EEAS).

Each one of the planned iMUGS demos will provide priceless information that will enable European countries to use unmanned vehicles for logistic and ISR functions, cutting down the troops' workload and boosting their safety.

The demonstration, a resounding success, focused on the project-developed swarming capability of unmanned ground vehicles (UGV) and execution of freight transport missions and reconnaissance tasks in built-up environments.

The demonstration was attended by representatives from industry, personnel of the European Commission and national representatives of member states participating in the consortium, such as representatives from the Subdirector General of Planning, Technology and Innovation of Spain's Directorate General of Armaments and Material (DGAM).

European Defence Innovation Day

The first European Defence Innovation Day held on May 31, was organized by the European Defence Agency under the auspices of the French Presidency of the Council of the European Union.

This high-level event, focused on driving European excellence in defense innovation, featured speakers from the EDA, the French Ministry of Defense, the

French Defense Innovation Agency, NATO, the European Commission, and industry representatives.

GMV participated in this event as part of CLAUDIA (Cloud Intelligence for decision making support and analysis), a four-year framework agreement signed with the EDA in 2019 for the development of a software platform enabling the use

of artificial intelligence and big data in a cloud infrastructure to improve the decision-making process, focusing on military hybrid warfare scenarios.

The closing address was given by Josep Borrell, High Representative of the European Union for Foreign Affairs and Security Policy and Vice-President of the European Commission.

Kickoff meeting of NATO's Alliance Future Surveillance and Control (AFSC) initiative

■ The kickoff meeting was recently held of one of the Risk-Reduction and Feasibility Studies for NATO's Support and Procurement Agency (NSPA), with the aim of defining a new technical solution for NATO's Alliance Future Surveillance and Control (AFSC) initiative.

The ASPAARO Consortium (Atlantic Strategic Partnership for Advanced All-domain Resilient Operations), led by Airbus Defence and Space together with Northrop Grumman Corporation, is made up by 9 frontline companies from both sides of the Atlantic, including GMV.

During the coming year the consortium will define its technical solution recommended for a totally distributed command, control and surveillance system, using groundbreaking technology based on open interfaces and standards for an operational, multi-domain environment.

A complete definition will also be made of feasibility, cost analysis and risks, as well as the required roadmap for the development of certain important technological areas.

The result of this and other studies will support NATO's future decision-making in setting up the new control, command and surveillance capabilities to meet future challenges and replace the current fleet of the Airborne Early Warning and Control System, due to reach its end of service by 2035.

GMV's experience in communications and information systems (CIS) for Joint Intelligence, Surveillance and Reconnaissance (JISR) systems stood it in good stead for participation in this initiative, confirming the establishment of a long-term cooperation framework to strengthen its position as a go-to supplier of NATO.

Defense industry as driving force for the economy and social welfare

On 10 and 11 May GMV took part in a conference entitled "The Defense Industry, A Driving Force for the Economy and Social Welfare," organized by the Federation of Industry, Construction and Agriculture of the General Union of Workers (UGT FICA) and the AGFITEL Foundation.

The event, which drew more than 120 representatives of public and private institutions in the defense industry, aimed to bring the industry closer to the public and highlight its strategic value.

Attendees were reminded that the defense industry provides jobs for more than 25,000 people and generates almost 6% of the industrial GDP in Spain. The importance of technology as a driving force for progress was also stressed, as was the need to increase defense budgets and make them more stable and predictable in the long term.

Several round-table discussions were held during the conference. Manuel Pérez Cortes, GMV's Defense and Security General Manager, joined other industry representatives in the discussion on technological innovation as the basis of the defense industry of the future and university-state cooperation.



GMV hosts the 2nd PROMENADE project meeting at its offices



■ On May 4th and 5th, GMV hosted the 2nd PROMENADE project meeting at its offices, which brought together almost 40 experts and professionals in the fields of border surveillance, artificial intelligence (AI) technologies, and big data.

Launched in October 2021, PROMENADE (ImPROved Maritime awareNESS by means of AI and BD mEthods) is a project focused on collaboration and R&D, co funded by the European Union as part of its Horizon 2020 framework program. The project's objective is to improve the systems used to track maritime vessels and to develop

artificial intelligence tools that can automatically detect anomalous behavior.

GMV's role in the PROMENADE project involves designing the solution, managing innovation, and developing services for satellite imagery merging, exploitation, and analysis. GMV is also the technological leader for the Spanish military, and the company will be working with top officials from the country's Customs and Borders service and Civil Guard police force, through implementation of PROMENADE services that can be displayed in Socrates. GMV is also

responsible for the platform used to bring together and perform testing of the project's assembly of software tools, which can also be used to run simulations.

Attendees at the meeting were able to share their knowledge and conclusions regarding newly developed requirements for the PROMENADE system. During the meeting GMV presented the design of various services designed for this project, as well as the state of the work package "Overall Design, Architecture & Interoperability Framework" it is currently leading.

GMV participates in the workshop "15" FORCE 2035 – Command and Control in the Protection of a Command Post

On May 25 the Engineers' Academy (Academia de Ingenieros: ACING) in Hoyo de Manzanares (Madrid) hosted the Workshop "15" companies FORCE 2035 – Command and Control in the Protection of a Command Post, organized by the Procurement Directorate (*Dirección de Adquisiciones*: DIAD) of the Army Logistic Support Command (*Mando de Apoyo Logístico del Ejército de Tierra*: MALE) and the Subdirector General of Innovation and Technological Planning (*Subdirección General de Planificación Tecnológica e Innovación*: SDGPLATIN) of the

Directorate General of Armaments and Material (DGAM).

The workshop was held in hybrid format (onsite and online) in a single day divided into three parts: an introduction; a symposium where firms, universities and research centers presented technological solutions and an exhibition.

It dealt with three main themes. Matching options on the national market with the needs of army units identified in the development of the Army 35 concept. Demonstrations of practices, technology

and necessary tools for achieving capabilities aimed at in army force 2035 in 3 timeframes: possible force (2026), advanced force (2030) and advantage force (2035). Encouraging interaction and exchange of information between companies, universities and research centers and technological associations.

As a standout technology firm, GMV naturally took part in this workshop, speaking about the use of command and control systems for arms systems and sensors and for protection of command posts from destructive threats (indirect fire, RPAS, sabotage).

GMV presents its extensive catalog of solutions, products, and services at Eurosatory

■ From June 13 to 17, GMV was present at the Spanish stand coordinated by the Spanish Association of Tech Companies in Defense, Security, Aeronautics, and Space (TEDAE) at the international defense and security conference Eurosatory.

GMV showcased the knowledge and technological capabilities it has achieved in the areas of aeronautics, defense, and security through its participation in top European programs.

As part of command and control, it presented the Foot Soldier System (SISCAP) and the JISR CSD-SIERRA suite at the service of several defense ministries. As a simulation, it presented the high-accuracy simulator for the WESCAM MX™ cameras by

L3HARRIS. It also presented one of its unmanned aircrafts (UAS), called SOLO and developed with Aurea Avionics. It also showed the navigation system for military vehicles, ISNAV, which will equip the VCR 8X8 DRAGON.

GMV had the chance to meet with clients and partners, including visits from the Secretary of State for Defense (SEDEF), the Directorate General of Weapons and Material (DIGAM), the Chief of the Army Logistic Support Command (JEMALE) and the director of Industry, Synergies, and Process Supervisors of the EDA.

Eurosatory 2022 was the ideal venue to showcase GMV's activities, interacting with sector experts and learning about new business opportunities at international level.

The defense industry as a driver of economic and technological development

On 12 May, as part of the course of High Strategic Studies for Superior Iberoamerican Officers given in the Higher Center of National Defense Studies (*Centro Superior de Estudios de la Defensa Nacional: CESEDEN*) a workshop was held under the banner theme: "The defense industry as a driver of economic and technological development".

The workshop was attended by about 40 superior officers from 15 Iberoamerican countries.

Ricardo Sáenz represented GMV as the company's director of Defense and Security Programs, participating in the debating panel together with other representatives from Amper and Navantia. Moderated by the general manager of the Forum of Renowned Spanish Brands (*Foro de Marcas Renombradas Españolas*), the panelists took stock of the current state of Spain's defense industry, public-private collaboration in said industry and the future challenges facing the sector.

According to the report "Economic and social impact of the defense, security, aeronautics and space industry", drawn up by KPMG in late 2021 for the Spanish Association of Technological Defense, Security, Aeronautics and Space Companies (*Asociación Española de Empresas Tecnológicas de Defensa, Seguridad, Aeronáutica y Espacio: TEDAE*), the economic impact of TEDAE's industries tops 16 billion euros. This figure represents 1.5% of Spain's GDP and 6.8% of its industrial GDP. The TEDAE industry ranks among the industrial leaders, with a direct GDP input higher than the chemical, textile and pharmaceutical industry. It is also a great driver of technological innovation and generator of skilled jobs on a national level, adding up to about 25,000 jobs in the whole of Spain.

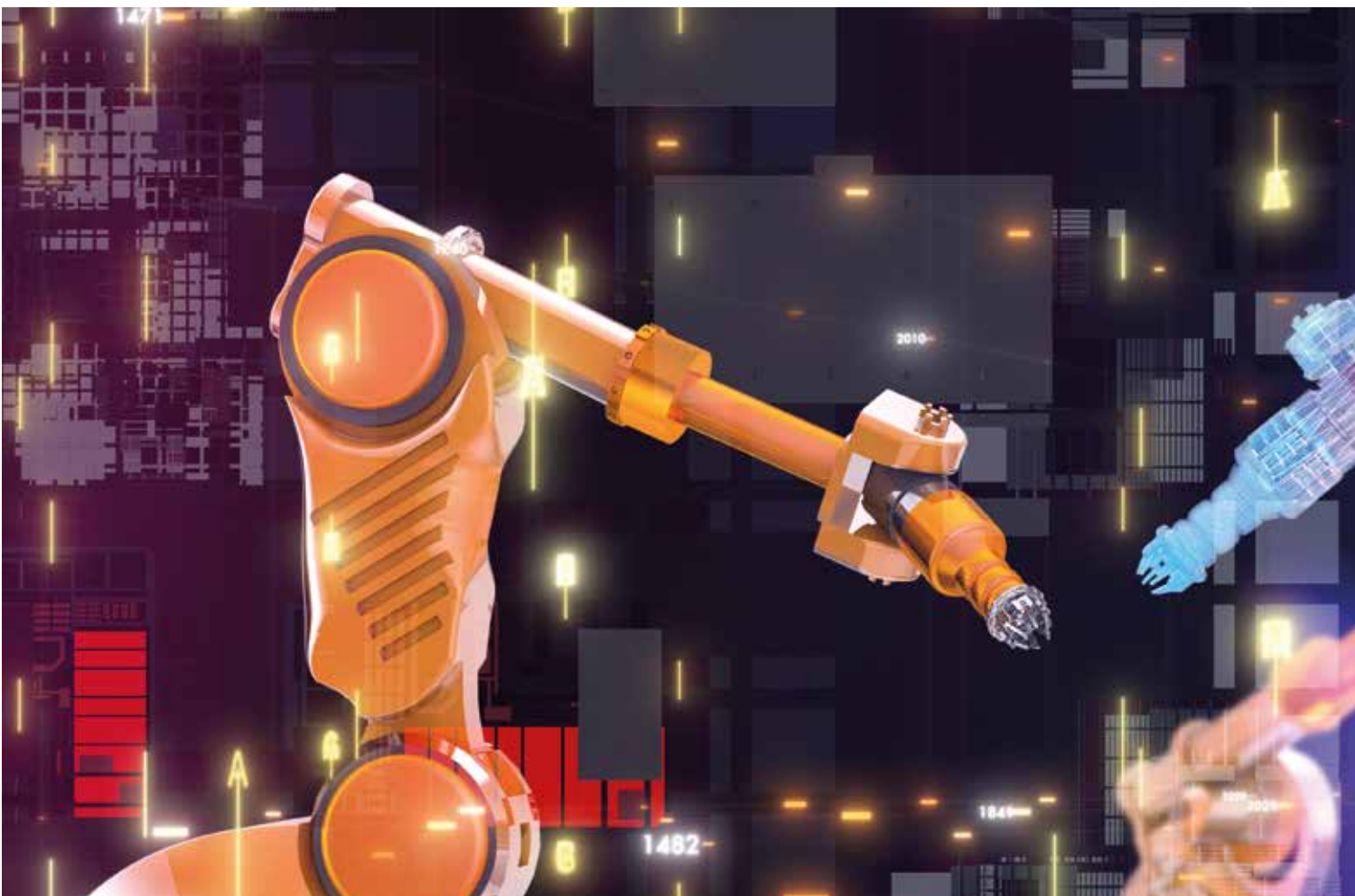


Industrial Cybersecurity: All-in approach in a digital transformation environment

GMV advocates a global approach to cybersecurity risks for industrial infrastructure subject to the most stringent management systems

Accelerated digitalization of automation and control systems, disruptive technology and increasing connectivity with other systems have together tended to expose industrial organizations to cybersecurity risks they were not ready for. In this digital transformation process one of the overriding ideas is for industry to become more competitive by tapping into data to hand within the factory itself. For instance, the introduction of IoT systems seeks to get the most out of available information with the final aim of making production more efficient and cost effective, so the resultant product has a greater market penetration. This exposes industrial environments to new threats with potentially critical effects on availability, integrity and confidentiality.

GMV is working towards an overall, design-up approach to cybersecurity risks for industrial infrastructure,



drawing on good practices and internationally recognized standards, identifying existing risks, protecting assets, heading off attacks or, if they happen, restoring the pre-attack situation as soon as possible, all orchestrated by means of the most demanding management systems.

Industrial cybersecurity success stories.

GMV has carried out for a cement-making organization a series of projects designed to perform the separation, segmentation and rationalization of communications between IT and OT data networks in its production plants in EMEA. Projects of this type, apart from implementation and configuration of firewall systems in said plants, imply an industrial asset discovery process, identifying too their communications with the rest of the assets —not only of the plant itself but also of the firm and even third parties such as certain public authorities— plus determination of information flow control policies. The

idea is thus to end up by defining a network architecture that comprises best practices for avoiding unnecessary or unauthorized access, safeguarding availability and proper working of industrial production systems.

Or take the automotive sector. The challenge here was sensorization of the vehicle assembly line to streamline the internal logistic process of vehicle parts. In this project GMV adopted a design-up security approach to underpin the whole architecture; this implies the proper choice of IoT systems whose working includes protection of communication processes, the use of device-level credentials to mitigate the risk of malicious devices and head off operational problems. Use was also made of a system architecture design based on micro-services, which seek not only granularity in the development of software but also maximum control of communications at both internal

level of the developed product and also in communications with third-party components such as the client's ERP systems, on which final supply of parts depends.

«Industrial cybersecurity has to factor in the following messages: security is security regardless of the particular field concerned or whether we are talking of corporate IT systems or operational OT systems; cybersecurity is not only a technological factor; it also takes in people, processes and knowledge; and, finally, we need to carry out our cybersecurity policy on the understanding that, sooner or later, we are going to suffer incidents» Javier Hidalgo, Cybersecurity Expert and Solutions Architect in GMV's Industry Sector, during his intervention in the event put on by Spain's Industrial Cybersecurity Center (CCI in Spanish initials): La Voz de la Industria 2022 «Management of and response to industrial cybersecurity incidents».



Cybersecurity, innovation and collaboration in "Wake Up Spain!"

■ From 4 to 8 April GMV took part in the second "Wake Up Spain!" forum held by El Español, Invertia and Disruptores e Innovadores (D+I). The central thrust of this forum is analysis of the various Strategic Projects for Economic Transformation and Recovery (*Proyectos Estratégicos para la Recuperación y Transformación Económica: PERTE*) that have been announced to date, assessing the main reforms adopted up to now in order to be eligible for Next Generation funds under the umbrella Resilience, Transformation and Recovery Plan.

This 5-day forum was attended by high-ups from government authorities of various levels and also from the private sector and associations to reflect on those questions impinging on Spain's economic development.

Luis Fernando Álvarez-Gascón, Director of GMV's Secure e-Solutions sector, acting as president of the Innovating Companies Forum (*Foro de Empresas Innovadoras*), and Javier Zubieta,

Marketing and Communication Manager of GMV's Secure e-Solutions sector and cybersecurity expert, took part in the discussion panels "From the innovation center to the firm" and "Cloud and cybersecurity" respectively.

From the innovation center to the firm

All Álvarez-Gascón's fellow members of the discussion panel agreed on the need to change the technology-transfer approach, referring to collaboration between innovation centers and companies. Álvarez Gascón stressed the importance of innovation as a source of economic growth and a pivot to reach social goals, especially sustainability.

In the executive's words: "a cultural change is needed; researchers and companies need to come together and get to know each other better, understand and appreciate each other; this hasn't happened hitherto". He also expressed the need for a cultural change in Spain's business managers

to take up innovation as a competition strategy.

Cybersecurity is intrinsic to digital development

On the panel dealing with Cybersecurity in the digital transformation, Javier Zubieta argued that a moment will come in which cybersecurity has been completely integrated into any digital system, "but until this actually happens, we need to be up and ready to protect ourselves the same as in the analog world". Zubieta also stressed the crucial role of employee awareness-raising.

Cybersecurity, calling for skilled professionals, is on an upward trend with no looking back. The panel members therefore agreed that a shortage of skills and the high turnover rate are the main problems faced by firms today. He pointed out that the latest reports drawn up by Experis Manpowergroup flags up a 240,000 person shortage for this year alone.



Opinion

How can we improve the response to cybersecurity incidents?

The role of protection technology is to head off any cyberattacks an organization may suffer. Significant progress in this endeavor has been made but internal security breaches still occur. What is even more worrying is the fact that breaches do not come to light, on average, until months after the onset. What is going wrong here?

The cybersecurity industry has placed huge stress on the development of monitoring technology. This generates a great deal of security alerts, all of which need to be diligently dealt with by the response team. We need to work from the premise that a security alert is nothing more than a case to be looked into with greater detail, in order to reach any solid conclusion. This investigation often has to be tackled by the response team with

only part of the relevant information to hand, downloading the information generated by the applications/services logs and network flows in order to find the necessary evidence to reach a correct conclusion on each of the thousands of alerts generated.

We who make up the most advanced response teams know that this metadata-analysis approach is no longer sufficient due to the sheer amount and complexity of investigations any organization nowadays has to carry out.

A proper analysis of many security alerts calls for a broad overview of the organization's activity in order to gain a proper understanding of the root cause of said alert. In many cases it is necessary to analyze aspects of this activity that spill beyond the time in which the alert was sprung. This in



Óscar Riaño
Head of GMV's CERT

"A proper analysis of many security alerts calls for a broad overview of the organization's activity"

turn calls for a responsive access to the raw data of the organization's activity, centering on data generated by final workstations and generated network traffic. Fortunately for our response teams, today's technology allows us to back up these needs; the main allies here are Endpoint Detection Response (EDR) and Network Security Monitoring (NSM) technology. EDR has by now been widely taken up, as a natural follow-on from traditional antivirus technology. NSM, however, which sets out to record raw network traffic that is then consulted by responding security analysts, has lagged behind. This means the teams are often working with insufficient information for a precise response to any security alert; there may therefore be cases that fly under the radar until it is too late.



Cybersecurity in tourism: a lurking threat



■ In April Barcelona hosted the 20th HOSTELCO, International Hotel, Restaurant and Hospitality tradefair.

The hospitality sector is currently immersed in a nonstop digitalization process. This greatly improves customer attention, but has also brought the whole tourism industry into the crosshairs of cybercriminals.

To tackle this problem, Joan Antoni Malonda, Tourism Business Developer of GMV's Secure e-Solutions sector, was

invited by the Spanish Confederation of Hotels and Tourism Accommodation (*Confederación española de hoteles y alojamientos turísticos*: CEHAT) and the Technological Hospitality Institute (*Instituto Tecnológico Hotelero*: ITH) to take part in the discussion panel "Cybersecurity: the lurking threat" together with Xavier García (Innovation Manager of Gremi d'Hotels of Barcelona), Esther Montalvá (Digital Affairs Manager of Madrid Lawyers' Association) and Isidro Fernández (CEO of Bumerania).

Malonda offered a series of recommendations to head off a possible threat "the best security is to prevent attacks of this type by all possible vectors. This will involve a previous check of all risks and threats, together with a good awareness-raising/training plan for cybersecurity employees; both actions are 100% essential".

Malonda argued that any security breach in a hospitality establishment would have its own idiosyncrasies, but it is always necessary to weigh up the scope and effect of the attack. Systematic response and recovery measures, such as a CERT, and a business continuity plan, would mitigate the damage beforehand. Otherwise the harm may be irreparable. Should the cyberattack affect personal data, moreover, article 33 of the General Data Protection Regulation (GDPR) stipulates that any attack likely to pose a risk for the rights and freedoms of persons has to be communicated to the control authority, in Spain's case the Spanish Data Protection Agency (*Agencia Española de Protección de Datos*: AEPD), and it might give rise to harsh penalties, from 4% of annual turnover to 20 million euros.

GMV brings cybersecurity in the post-quantum era to the STIC Colombia Conference

■ GMV attended the STIC Colombia Chapter Conference, held for the second year running in Medellín (Colombia) from March 16-18. The event was organized by the National Cryptologic Center (CCN), the National Institute of Cybersecurity of Spain (INCIBE), and with the support of CSIRT Americas Network of the Inter-American Committee against Terrorism of the Organization of American States (OAS).

Over the course of three days, leaders from the world of cybersecurity met with the aim of promoting and publicizing the activities and cooperation mechanisms of

organizations and companies from Latin America and Spain, strengthening cybersecurity at the international level.

As well as showing its support as sponsor of the conference, GMV was represented by Óscar Gaspar, country manager in Latam of GMV's Secure e-Solutions sector, who gave the paper "Cybersecurity in the post-quantum era", in which Gaspar reviewed the state of the art, evolution and impact of quantum computing in the world of cybersecurity.

GMV is a benchmark in the field of quantum computing; it is currently

leading the CUCO project consortium, which is investigating the use of quantum technology and its application to strategic industries. The consortium is made up of seven companies (Amatech, BBVA, DAS Photonics, GMV, Multiverse computing, Qilimanjaro Quantum Tech and Repsol), supported by five research centers (BSC, CSIC, DIPC, ICFO and Tecnalia) and a public university (Universitat Politècnica de València). It is subsidized by the CDTI and supported by the Ministry of Science and Innovation under the Recovery, Transformation and Resilience Plan.

GMV highlights its track record and commitment to cybersecurity in Andalusia's 1st Cybersecurity Congress



■ In late March, GMV took part in the "1st Cybersecurity Congress of Andalusia", organized by the Regional Council of Andalusia through the Digital Agency of Andalusia (ADA). Patricia Tejado, Director of Digital Public Services of GMV's Secure e-Solutions sector took part in the panel discussion moderated by Susana Carillo, Deputy Mayor of the

Innovation and Urban Digitalization Area of the City of Malaga.

In her presentation she underlined GMV's involvement in the development of cybersecurity solutions from the very beginning; its application to sectors such as telecommunications or public administration; and the way in which GMV is tackling the new

challenges generated by such strategic sectors as industry, transport and aeronautics.

As an example of GMV's track record and commitment to cybersecurity, Tejado highlighted the setting up of GMV's CERT, as well as some of its actions: the system for detecting cyberthreats to the healthcare system set up during the Covid-19 pandemic and the reinforcement of critical infrastructure monitoring on the occasion of the war in Ukraine.

On the other hand, Tejado underlined the good relationship between cybersecurity and innovation and took advantage of her participation to encourage public managers and the Administration in general to launch challenges that stimulate private companies to develop new solutions since, in her opinion, "there is still a lot to be done in this area". Likewise, and in order to continue moving forward, Tejado brought up the convenience of creating a horizontal regulation that contemplates the inclusion of cybersecurity requirements in the bidding specifications for digitalization projects; something that, in her words, "would greatly help to provide secure and higher quality public services".

CYSAT 2022

GMV sponsored CYSAT 2022, Europe's only event given over entirely to cybersecurity for space applications, held in Paris in April.

CYSAT chose a roster of over 50 speakers, including Julio Vivero, Business Partner of GMV's Secure e-Solutions sector and David de la Hoz, SevDevOps & Security Monitoring of GMV's Secure e-Solutions sector, who talked about their expertise

and experience of today's cybersecurity problems affecting commercial space applications and GMV's range of solutions to deal with them. Juan Carlos Gil, Satellite Control and Mission Planning PMO of GMV's Aerospace Sector, helped to give the user's viewpoint of these applications.

Furthermore, Miguel Ángel Molina, GMV's manager of commercial development and

strategy for the ground segment area and space operations, took part in the think tank "Protecting European space assets: an industrial perspective".

CYSAT's remit is to bring together the space security and IT communities to build a European cybersecurity setup capable of rising to the current and future challenges faced by Europe's space industry.





Diagnosing illnesses in outer space

GMV proposes a technological solution that allows personnel unspecialized in radiology to obtain clinically important images of organs to be sent to earth for analysis and interpretation by clinical specialists

GMV, within the ALISSE project, is working on the development of artificial intelligence technology based on deep-learning techniques to guide and help astronauts in acquiring high-quality diagnostic ultrasound images of the various organs affected by the conditions of crewed space flights. This will help specialist clinicians to identify remotely from earth any possible effects at an early stage and apply the remedy to suit.

ALISSE's clinical partner is the Urgency Radiology Section of the Hospital Universitario La Paz run by Milagros Martí de Gracia. For their part researchers from the Nuclear Physics group of the Universidad Complutense de Madrid (UCM), led by Jose Manuel Udías Moinelo, collaborated in the generation of uncannily realistic simulations to improve system robustness in an environment as unknown as outer space.

In the words of Carlos Illana, product head of GMV's Secure e-Solutions sector, "ALISSE is investigating new artificial-intelligence techniques to guide and assist crew members in receiving diagnosis-quality images without needing to engage in an interactive consultation with specialist clinicians on earth. Any effects on spacecraft crew members can hence be detected in an

early stage and monitored by ultrasound images".

Due to the relative closeness of the International Space Station (ISS), the medical team on earth can guide astronauts in the use of ecographs to obtain medical images by video-conference during medical explorations. On missions where the distance from the earth is greater, however, the delay in receiving images and in communications in general hinders proper medical exploration and rules out the use of video-conferencing as a means of obtaining precise medical images for diagnosis purposes.

On a hypothetical mission to Mars the crew will be between 54 and 402 million kilometers from earth, and it will be impossible to return to earth to receive urgent medical treatment. Telemedicine and remote guidance techniques would fall short of the necessary image quality and suffer from too long a delay in the radio communication signal, which would require 20 minutes on both legs of the Mars-Earth journey. To solve this problem GMV has proposed a system that allows personnel unspecialized in radiology to obtain clinically important images of organs to be sent to earth for analysis and interpretation by clinical specialists, in order to arrive at a proper diagnosis and prescribe the clinical treatment accordingly.

GMV's commitment to healthcare aims to harness the advantages of the Spanish healthcare system



■ GMV took part in the 5th Artificial Intelligence Summit 2022 organized by AMETIC at the end of April and attended by the Secretary of State for Digitalization and Artificial Intelligence, Carmen Artigas.

Inmaculada Pérez, Digital Health Manager of GMV's Secure e-Solutions, took part in a panel discussion centered on the application of artificial intelligence (AI) to healthcare.

AI has made great strides in Spain over the last five years. It is now a driver of industry, the economy and sustainability. In the specific case of the healthcare sector

the application of AI-linked technology really comes up trumps in two factors of healthcare management. Inmaculada Pérez, Digital Health Manager of GMV's Secure e-Solutions sector, explains this duality: firstly it helps to speed up diagnoses and make them more efficient and, secondly, it facilitates personalization of treatment and continual patient monitoring. Resource allocation is thus improved, with a positive knock-on effect on healthcare sustainability. Additionally, AI helps to speed up research projects in various healthcare areas, especially the development of new drugs.

The main obstacles to AI solutions in the healthcare sector largely mirror those found in the finance sector, deriving mainly from data access, security, interoperability and privacy. GMV argues that the solution to this problem depends on finding a way of sharing and reusing data among the various stakeholder organizations inside and outside the health system, so that AI models can be trained up securely.

Along these lines GMV is working within the Tartaglia project to set up AI mechanisms within federated data

networks. This means that data would never leave its point of origin and would therefore not have to be anonymized, with the concomitant loss of algorithm quality and efficacy. This favors distributed training of AI models whilst always respecting the data subjects' rights, in this case the patients. Projects like TARTAGLIA, GMV argues, mean that companies like GMV itself can provide healthcare innovation and promote Spain from a position of mere passive receiver. This will enable the opportunities offered by the Spanish health system to be fully and properly exploited.

This idea received further support in the 5th Artificial Intelligence Summit 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), where the Secretary of State for Digitalization and Artificial intelligence, Carmen Artigas, argued that Spain's level is "surprisingly high in terms not only of inclusion but also sustainability and health, where we have seen great examples in both the private and public sector".



The role of innovation and safety in biomedical research

■ "Innovation and biomedical security: two sides of the same coin" was the title of the working session organized by InNorMadrid in collaboration with GMV on May 24.

The event, moderated by journalist Francisco García Cabello, brought together experts in the field of biomedical research and cybersecurity.

Cybersecurity and the guarantee of data privacy are two absolutely crucial factors in biomedical research. The information being worked with is very sensitive, dealing as it does with clinical tests, the development of new drugs, patents, intellectual property, etc. In the words of César Hernández, head of the Medicine Department of Human Use of the Spanish Agency of Healthcare Product and Medicines (Agencia Española de Medicamentos y Productos Sanitarios: AEMPS) "we

need to work towards a transparent data governance in relation to the evaluation of the security and efficacy of clinical tests and new drugs". For his part, Javier Candau, head of the Cybersecurity Department, CCN-CERT, argues that "there is no digital transformation without cybersecurity in this sector either and surveillance against any cyberattacks has to be built-in and nonstop. Zero trust is a must".

GlobalData's report "Emerging Technology Trends Survey" stresses pharma executives' concern about this matter. Thus, over 70% of respondents who have some level of responsibility with regards to the implementation of new and emerging technologies prioritize cybersecurity (73%), cloud storage solutions (71%) and Big Data (71%). Big datasets need a high level of security pertaining

"AI needs data; the more data it works from, the more efficient are its algorithms"

to information-processing, -transfer and -storage.

Javier Zubieta, a cybersecurity expert working as Marketing and Communication Manager of GMV's Secure e Solutions sector, puts it this way: "AI needs data; the more data it works from, the more efficient are its algorithms. That said, if the data is not properly protected, the whole system is either lame or completely invalid. Neither should we forget the regulatory and legislative pressure that calls for higher measures of protection in a healthcare context. Cybersecurity therefore looks out for the protection of data privacy and facilitates and levers AI".



Tartaglia partners meet up in gmV to take stock of progress so far



■ Coordinators and specialists of the different work packages of the Tartaglia project have met up on GMV's site to swap notes on progress made in the first months.

Tartaglia seeks to set up a federated network with artificial intelligence to speed up clinical and healthcare research in Spain. The project falls under the umbrella program R&D Missions in Artificial intelligence of the Digital Spain Agenda 2025 and the National Artificial intelligence Strategy, with EU Next Generation funding.

GMV, as global leader of TARTAGLIA, is coordinating the whole project and tapping into the most advanced cryptographic methods to keep patient data encrypted while all necessary calculations are performed, thus striking the right balance between privacy and the possibility of mining the data without moving it from its original site or exposing it. All this spadework will favor better training of mathematical models to support decision making while promoting personalized and precision healthcare, improving patient

treatment and speeding up clinical tests, among other matters.

GMV is also responsible for a work package that aims to obtain diagnostic ultrasound images, guided by artificial intelligence. After this first meeting the teams of GMV, Hospital Val d'Hebron, Universidad Complutense de Madrid and the company Dasel then took part in a training meeting in Barcelona. Here hospital specialists held demos of echocardiograms while identifying the most common difficulties found by users.

The madrid digital health cluster welcomes GMV as a new member



■ Brokered by the Directorate General of Economy of Madrid City Council, the Madrid e-Health cluster brings together companies, associations and institutions,

both public and private, to carry out activities in the city of Madrid and its hinterland and to freely associate in order to promote growth of the digital healthcare sector, paying special heed to the challenge of active and healthy ageing.

The Council, through its Area of Families, Equality and Social Welfare, offers a series of services (home delivery, telemedicine, care homes for day attendance or residence) and carries out initiatives and plans under such banner names as "Madrid Acompaña" (Madrid with the Elderly) or

"Madrid Ciudad Amigable con los Mayores" (Madrid an Elderly-Friendly City). The aim of these initiatives is to give the elderly top-quality local services. The City Council of Madrid is promoting "MAD e-Health" in order to bring local skills and services into line with the main goals of the Cluster, including: promoting economic activity; support for innovation and the use of technology to support healthcare development in the City of Madrid while looking further afield to a national and international level; nurturing the quality of life of the elderly and ensuring healthy ageing.

GMV participates in the european data space Gaia-X

■ Europe's public-private initiative "Gaia-X" has been set up to make further headway in the creation of a common shared-data model in various EU countries and sectors that guarantees trustworthiness and data sovereignty. Taking up the baton, the Government of Spain has set up a national Gaia-X hub to roll out the data economy and work towards data space leadership in strategically important sectors like tourism and healthcare, both business lines of GMV.

In the healthcare sector accessible data is essential in order to glean the necessary knowledge and insights to improve prevention and personalized healthcare and drive healthcare policies and medical innovation. GMV boasts a wealth of experience in interoperability and common models of healthcare data; for years it has been working with the common healthcare data model OMOP, which has stood it good stead for its participation in Gaia-X and reinforces its marquee status in this field.

This knowledge was shared by the company in its presentation of the



healthcare project of Gaia-X called "Health-X GMV" within the panel organized by the Biocomputing Unit of the Healthcare Sciences Institute of Aragón. This institute is Spain's representative of the European Commission's joint action project TEHDAS, which is laying down European principles for secondary use of healthcare data.

The Gaia-X framework enables healthcare data spaces to become citizen-centered and sovereign, so they can be scaled up with confidence. These data spaces integrate existing data initiatives in a federated structure and invite new initiatives to join the fold, all in the interests of making medical progress, cutting costs and improving healthcare for one and all.

HARMONY'S big data platform harnesses the power of data to predict the survival of patients with blood cancers

■ Researchers from the HARMONY Alliance and the European Myeloma Network have published the results of their work in the specialized Journal of Clinical Oncology (JCO), aimed at improving the survival prognosis of newly diagnosed multiple myeloma (NDMM) patients, as well as providing information to help specialists make treatment decisions.

The study of anonymized data from 10,843 newly diagnosed multiple myeloma (NDMM) patients, collected through the European Myeloma Network within the HARMONY project, has developed and validated the R2-ISS

(Revised International Staging System), determining the additive value of unique risk characteristics in predicting progression-free survival and overall survival of these patients.

An improved staging system can help oncologists more accurately determine the prognosis of patients with newly diagnosed multiple myeloma (NDMM). Oncologists can use the improved system to identify high-risk patients more reliably, and to make better informed treatment decisions.

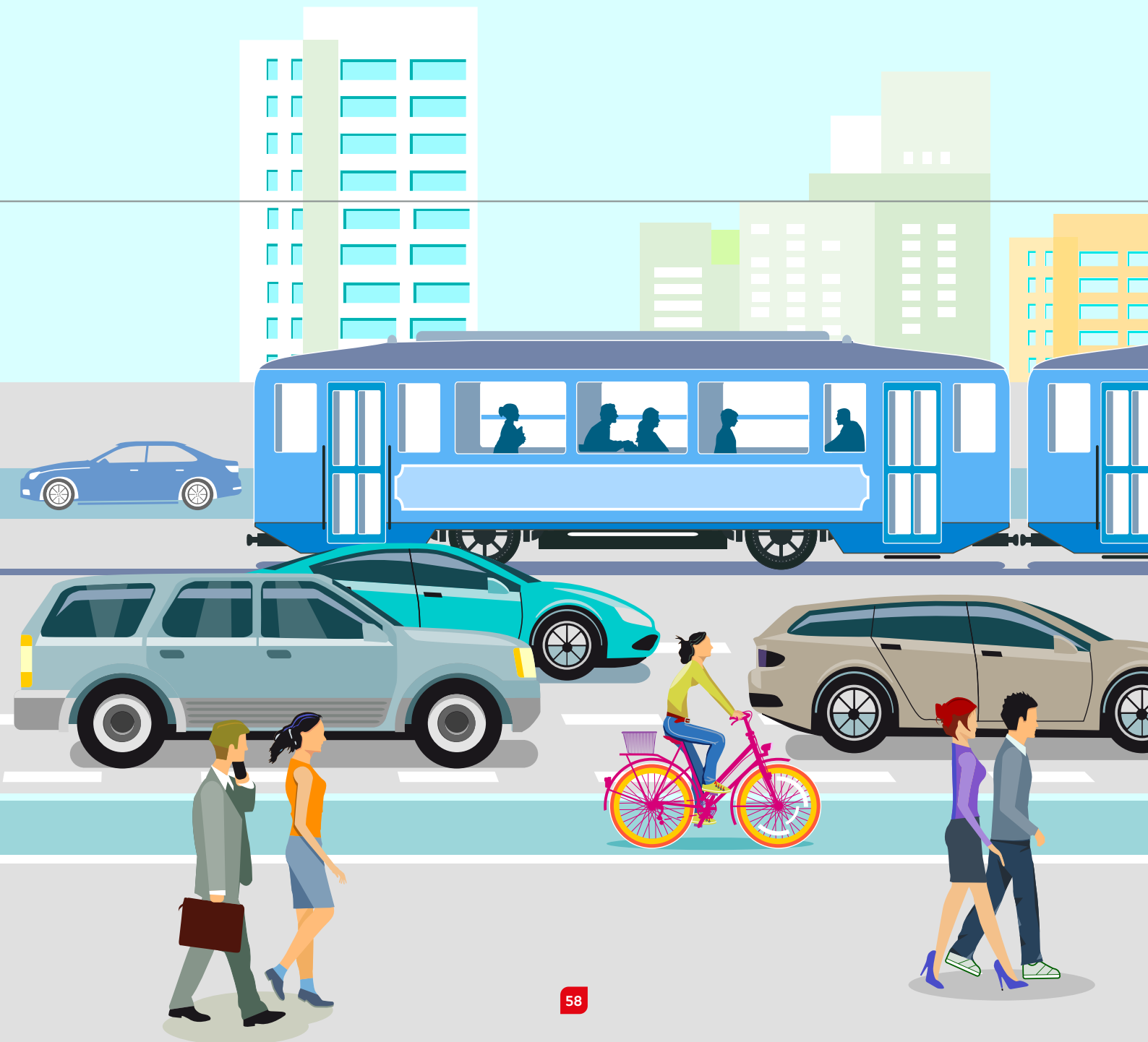
Clinical outcomes vary widely for patients with NDMM, with survival

ranging from a few months to more than a decade. Currently, oncologists use the "Revised International Staging System" (R-ISS) to classify the prognosis of these patients as good, intermediate or poor. R-ISS is based on widely available biomarkers. Approximately 62% of patients with NDMM are at intermediate risk according to the R-ISS.

These advances will be shared at the next Annual Assembly of the HARMONY Alliance, to be held next October in Palma de Mallorca, together with the GMV-developed technology that has facilitated the work of researchers.

GMV wins the contract for the management system of Bilbao and Vitoria's trams

The system, based on GMV's inhouse railway fleet-management system **SAE-r®**, is to be phased in with several external systems covering the various stages of railway traffic management



Euskotren, operator of Euskadi's public transport, awards GMV the contract for developing a management system for centralized operation of the trams of Bilbao and Vitoria, as well as the railway the company runs too.

This system, based on GMV's inhouse railway fleet-management system **SAE-r**[®], is integrated with several external systems covering the various stages of railway traffic management. The system itself can also act in its own right if need be, adding greater robustness to Euskotren's set of systems.

The first stage (schedule planning) comprises importing or drawing up and

exchange of the running plans to be used in the future. These plans take in traffic as a whole, comprising the railway network together with the tramlines of Bilbao and Vitoria for one or more typical days to be applied to a calendar that then determines the plan to be uploaded.

The next, real-time stage keeps a track of traffic on the various networks for each particular day, whether trams or trains. The system can react to any deviations that might occur, tweaking the uploaded plan to suit or loading a different plan if need be, manually reallocating affected rolling stock and staff, etc. The upshot is continual amendments throughout the day, keeping the system updated and in line with other external systems.

Finally, in the last stage, the system analyzes past running, drawing up a series of personalized reports.

A similar system, also based on SAE-r, has been up and running for several years in the Basque railway manager, Euskal Trenbide Sarea (ETS). This system, called graphic service application, is soon to be enlarged. ETS awarded GMV the contract for grafting onto this system a passenger information system module in stations.

This new model will ensure efficient and standardized management of the various station passenger information systems, with some monitors showing a website and others only lines of text.



GMV to supply the new commuter service trains with the "Communications Platform"



■ Alstom has turned to GMV for supplying the "Communications Platform" to be fitted in the new commuter trains in turn to be supplied to Spain's national operator RENFE.

The platform is to be fitted on the 152 new trains making up the first lot awarded by RENFE to increase its local, commuting fleet. These new trains can take on or remove cars, changing back and forth from trains of 80 or

120 meters respectively, on a demand response basis.

The onboard communications platform (or PDCE in RENFE terminology) has already been fitted to the rest of RENFE's commuter fleet, allowing management centers to monitor the location of each train, communicating live with the driver and passengers and viewing incidents in real time, while in turn receiving a host of information from onboard systems

connected up to the platform, allowing managers to act accordingly in order to guarantee continuity of the passenger service.

The PDCE incorporates an onboard control unit connected up to the train's Ethernet backbone and takes information from the diverse connected systems. One of the main functions is tracking, combining GPS information with the train's odometer. This tracking, together with the other service information, will be sent up to the control center by means of the corresponding communication router.

The communications platform is connected up to the diagnosis system, the energy metering system, the juridical recording unit (JRU), the passenger information system, the PA system and video-surveillance system and the ridership counting system.

Real time information is taken from all the above, as well as cumulative historical information, for use onboard and to be sent on to the control center for reference by RENFE personnel.

GMV participates at the 22nd Spanish ITS Congress

The 22nd edition of the Spanish Intelligent Transportation Systems (ITS) Congress took place in Madrid from April 26-28. The purpose of this event was to bring together the country's experts in the field of intelligent transportation systems, to discuss new solutions, advances, and trends in the industry.

The themes addressed during this edition included intelligent infrastructure, connected mobility, smart cities, and payment digitalization for public transportation systems.

In its role as a sponsoring partner, GMV had a stand at the event to present its own intelligent transportation solutions.

The company also gave presentations during each of the thematic sessions. Specifically, representatives from GMV spoke on the subjects of ecodriving for the Avanza fleet in the Madrid region; the Enhanced Galileo Green Lanes project; the future user information and video-surveillance system for Barcelona's urban buses; the future computer-aided dispatch system for the collective public

transportation service operating in the municipalities of Castelldefels, Gavá, Viladecans, Barcelona, and other nearby locations; and updating of the city of Granada's public transportation network with a next-generation ITS system.

With its participation at this Congress, GMV has reinforced its leadership position in the fields of design, development, implementation, and launching of intelligent transportation systems (ITS), along with its ability to offer integrated, turnkey solutions ready to be put into operation.

GMV wins a new contract for Malaga tramline

The ITSs forming part of this contract are the passenger information system, the PA and intercom system and the video surveillance system or CCTV

The train manufacturer *Construcciones y Auxiliar de Ferrocarriles (CAF)* awards GMV the contract for supplying several of the systems to be fitted on its 5-car URBOS trams for its recent Malaga tramline project. Under this contract four URBOS trams to run in Malaga will be fitted with these systems.

The ITSs forming part of this contract are the passenger information system, the PA and intercom system and the video surveillance system or CCTV. Also to be supplied under this contract is the onboard communications Ethernet, with a built-in LTE /Wi-Fi router for

communications between train and control center.

Passenger information is to be shown on both front and side LED panels, connected up to the system controller, as well as 21.5" TFT panels distributed throughout the whole train. The control element will generate both service information and schedule publicity content, enhancing passengers' overall traveling experience.

The PA system, also distributed throughout the tram, is mainly digital, incorporating also a backup analog to boost system dependability. The intercom has 14 IP terminals set up close to the

doors, ensuring quick passenger attention in the event of any emergency situation.

Lastly, the CCTV system comprises one digital video recorder per tram, which will record the IP cameras fitted throughout the train, plus front-mounted cameras fitted in both cabs. Rear-view cameras are also fitted, displaying the entrance doors and areas surrounding the vehicle. The system is topped up with a 12" cabin monitor, which displays real time images of whatever is happening onboard.

All these systems will be phased in with the train's monitoring and control system to receive all necessary control information to report states and alarms.



GMV supplies Casal's new ITSs for the urban transport of Alcalá de Guadaira



■ Casal, a company belonging to Grupo Baixbus, won the urban transport concession for Alcalá de Guadaira (Seville) and then turned to GMV to supply its new ITSs. Under this agreement GMV is to supply Casal with its inhouse fleet management system, the passenger information system and video surveillance system (CCTV).

This new contract builds on GMV's longstanding business relationship with Casal and makes it one of

the latter firm's go-to technology suppliers.

Casal has contracted from GMV the new ITSs for a 7-bus fleet and technology for the 6 bus-stops on the urban passenger transport route within the municipal district of Alcalá de Guadaira in Seville.

GMV will fit Casal's buses with onboard equipment for the fleet management and passenger information systems, plus the video recorder of the CCTV system,

comprising 2 IP cameras per bus. The passenger information system displays onboard passenger information on a TFT panel.

The contract also takes in supply of 6 bus-stop LED information panels plus an IOS- and Android-enable App and a passenger information website. At control center level GMV will supply its fleet-management and CCTV backoffice systems for operation and management of the onboard and bus-stop ITS technology.

New North America ITS Clients

■ GMV's subsidiary in the U.S. has been awarded a new CAD/AVL project for 8 urban transit agencies in North Carolina, USA.

This project, initiated by the Piedmont Authority for Regional Transportation (PART)

in Greensboro, represents GMV's first fixed route clients in North Carolina. The deal features CAD/AVL solutions for 200+ fixed route transit buses as well as Next Stop Announcements, Automatic Passenger Counting, and other technologies.

Public transit requires efficient real-time management and effective planning and analysis tools. To achieve that, GMV's CAD/AVL (computer-aided dispatch / automatic vehicle location) is a tool that offers business intelligence solutions and new developments such as "Eco Driving" or onboard security.

New video information system for Jerusalem light rail

GMV will carry out a new project to provide Jerusalem light rail passengers with multimedia information

G MV will supply and implement a new video information system for passengers on 114 new trains that will operate on Jerusalem's light rail network. These new trains are to run on this network's red lines (already up and running but now being extended to the north and south) and also on the newly constructed green line.

This system complements the fleet management system, also called Automatic Vehicle Location System (AVLS), now being set up by GMV in the same tramline, based on GMV's inhouse

railway and tram fleet-management system GMV **SAE-R®**.

Planned in synchronization with the manufacture of new trains, this enlargement involves the fitting of 684 state-of-the-art 28" TFT panels (6 units per train) with a new stretch format. Each one of these monitors, fitted over each one of the doors is connected up to the train's onboard Ethernet for digital streaming of passenger information.

This new interface will allow the operator to provide passenger information in video and text format, combining service information and publicity. A variety of

graphic elements will be presented, included a geographic map for real time display of service information. This map will include both train tracking, ETAs at the various stations of the particular route and connections with the city's other transport systems (buses, trains) at each stop.

The information to be displayed and its associated content will be configured and programmed from the operation and control center, as with the network's AVLS. For this purpose the operator will be using the Content Manager and Topology Editor, supplied by GMV as part of the project.



GMV Delivers New CCTV Surveillance System in Szczecin



■ As part of a project for the modernization of the onboard systems on 11 trams belonging to the municipal company Szczecin Trams, in early 2022, GMV was entrusted with thoroughly modernizing the video surveillance system (CCTV) previously supplied by Novamedia with a complete replacement of the system's devices.

GMV will deliver and install on each of the 11 trams a set consisting of a REC30v4 recorder equipped with 2TB SSD disks, 11 video cameras (6 internal cameras observing the passenger area, 3 external cameras observing the side area in front of the entrance

to the tram, 1 camera observing the cockpit and the tram driver post, 1 camera directed at the driving track), 1 microphone for audio recording, and other equipment, such as switches for creating an onboard ETH network.

The recorder's software will automatically describe the video material with additional information such as vehicle number, line, the task performed, vehicle speed, camera number, date, and time, which will facilitate the identification of files and their subsequent use as evidence. All recordings remain encrypted in the recorder's memory. The recorder's

software will also be equipped with the master Onboard Video Surveillance System managed by the Authority (ZDiTM) in Szczecin.

This will enable dispatchers to obtain a preview of video images from onboard cameras in real-time, search the recordings remotely and download them to a central server via cellular network or depot Wi-Fi, in addition to decoding the images.

Since 2015, ZDiTM has been running a centralized system on more than 400 trams and buses in Szczecin equipped with GMV recorders.

Arriva extends GMV's maintenance contract for another ten year term

■ In 2021 GMV signed with the Galicia firm Arriva a contract based on corrective and preventive maintenance of the backoffice applications of the fleet-management and ticketing systems. These applications are supplied to the operator as Arriva's operating concession is renewed with the Regional Authority (Xunta) of Galicia, including maintenance of the local fleet management system together with the central fleet management system of the Galicia Mobility Operation Center (*Centro Operativo de la Movilidad de Galicia: COMGA*) on the basis of protocols defined by Mobilidade and the Agency for the Technological Modernization of Galicia (*Agencia para la Modernización Tecnológica de Galicia: AMTEGA*).

The guarantee term of the fleet-management and ticketing equipment (190 **ETC-6061** ticket vending machines, 190 **M20** onboard units and the necessary installation material) has now drawn to an end, so it is now to be extended for another 10-year term under a contract signed in 2022. This transaction is based on remote technical assistance for onboard fleet management and



ticketing equipment and any incidents in ticket office software during GMV's working hours.

It also includes remote corrective maintenance based on attention to software and firmware incidents with a service time broken down by levels of criticality (critical in less than 2 hours, grave in less than 24 hours and minor in less than 72 hours) within the working hours, plus management of obsolescence to ensure continuity of system hardware during the 10-year life cycle. Lastly, it also includes maintenance management based on

monitoring of incidents and work orders recorded in the maintenance website by the project head and drawing up of a monthly monitoring report.

In 2021 this contract included other maintenance services such as monitoring of the Xunta's control of credits, maintenance of the web applications of the online sales service and updating of configuration, plus maintenance of any additional functions required by the operator in the onboard ticket machine on fares, acceptances, inter-line card recharges and control of the bus's display panel.

GMV renews a contract with the Cyprus Transport Ministry until 2026

■ GMV recently signed a maintenance contract with the Cyprus MoT for 40 onboard TFT screens, 40 bus-stop panels powered by a photovoltaic system and set on the main thoroughfares of Limassol, plus software maintenance for content management of the abovementioned screen- and panel-information.

The onboard screens show next-stop information and publicity, while the bus-stop panels show ETAs of the next bus. Passenger information is shown in Greek and English.

The maintenance level is based on remote technical assistance for the abovementioned items: remote corrective maintenance to deal with any software or firmware incidents, broken down by level of severity and impact (critical or level 1, major or level 2 and minor or level 3), plus preventive bus-stop panel maintenance twice a year.

Onsite maintenance work in Limassol has been subcontracted out to Air Control.

The maintenance term is five years, ending in late 2026.



Management of low-emission zones, urban tolling and mobility innovation

The Climate Change Law passed in Spain in 2021 stipulates those subjects who are bound to take up mobility plans for creating Low Emission Zones (LEZs). The idea of a LEZ is to limit access of the most polluting vehicles, also seeking to cut down traffic congestion and noise levels, while also boosting road safety. Affected cities are working on the scheme with the backing of the Spanish Ministry of Transport, Mobility and the Urban Agenda (*Ministerio de Transportes Movilidad y Agenda Urbana*: MITMA); meanwhile the Ministry of Environmental Transition (*Ministerio de Transición Ecológica*: MITECO) is drawing up the LEZ-regulating decree.

Promising initiatives have already been set in motion to deal with this issue, such as the Network of Cities with Low Emission Mobility, promoted

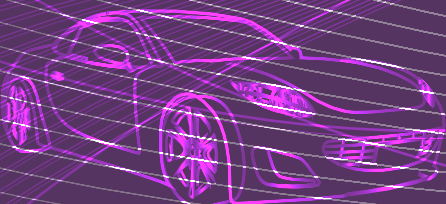
by the Smart Mobility Forum. This network, comprising local authorities, associations, companies and other groupings, aims to identify and promote solutions and strategies to reduce mobility emissions and their effect on citizens.

All to the good, but the deadline for setting up LEZs is now almost upon us. There is now a need for specific regulation on how to set up LEZs in general, providing legal security and clarity for users, companies and the public at large. It should be borne in mind here that, only a few weeks ago, the Higher Court of Justice of Catalunya (*Tribunal Superior de Justicia de Catalunya*: TSJC) annulled the bylaw drawn up by the Metropolitan Area of Barcelona (*Àrea Metropolitana de Barcelona*: AMB), weighing up socioeconomic factors and LEZ impact on sectors affected by the mobility constraints brought in or alternative

measures that might mitigate traffic-limitation effects.

Public tenders are also underway for the planned LEZ-implementation and other sustainable mobility measures, drawing on an initial budget of 1 billion of the 1.5 billion euros of Next Generation EU funds set aside for measures of this type.

Although there are many possible ways of setting up these systems, an overwhelming majority fall back on license-plate recognition cameras. Cities like Oslo or London have been using control schemes for quite some time now. Others like Brussels have decided to go one step further, putting forward schemes like SmartMove. This is a groundbreaking Global Navigation Satellite System (GNSS)-based and cellphone-using system to lessen Brussels' congestion. As such it is citizen-centered; there is no need for



"GNSS is a mature, reliable technology with excellent performance, proven and successfully deployed in low-emission areas"

them to buy costly devices or make do with monitoring cameras; rather can they access several different mobility services from their own cellphones.

Cutting-edge technology like GNSS has proved to be crucial for rolling out multiple mobility solutions. It has become by now a byword for our daily satnavs too. But little has hitherto been said about the crucial role it might play in setting up LEZs, urban tolling systems and modern smartphone-based mobility services. GNSS could really come into its own here.

The benefits could be manifold: great flexibility, scalability, cost-trimming and synergies with other value-added services, among others. It is by now a mature, trustworthy and smoothly performing technology, tried and tested in schemes that are conceptually very similar, such as

the various national schemes of road user charging (Toll Collect in Germany, Skytoll in Slovakia and Viapass in Belgium).

Neither should it be forgotten here that the promotion of technology like GNSS and transport digitalization could also prove an economic boon. The GNSS-enabled device market (including smartphones) has matured in the last decade; revenue from GNSS services soared to 73 billion in 2021 and it is expected to reach 250-billion euros by 2031, a compound growth rate of 15%. Autonomous driving, smart traffic management systems, smart applications and mobility as a service all depend on GNSS for their high precision and reliability.

We therefore face the challenge of becoming a country of great digital density, and mobility has to be one of the prime factors in this endeavor.



*Sara Gutiérrez Lanza
Manager of the Automotive Business Unit of GMV's
Intelligence Transport Systems sector*

Spain, boasting an impressive roll call up of frontline organizations with proven experience, can and should play a significant role in the near future.

SATELISE® wins the ITS 2022 prize

■ The ITS 2022 prizes were handed out in the closing ceremony of the 22nd Spanish Congress on Intelligent Transportation Systems (ITS), held in Madrid from 26 to 28 April.

Prizewinner under the heading of "Toll roads" was SATELISE®, Cintra's trailblazing initiative carried out by GMV for GNSS- and smartphone-based infrastructure user charging.

SATELISE® is a system based on standard smartphone GNSS-based geopositioning devices, tapping into the smartphone's own functions. This

system has been developed in an Android- and iOS-enabled smartphone app.

The SATELISE® mobile app, also being used on "Autema", the toll road running from Terrasa to Manresa (Catalunya), and on Portugal's A22 and A38 toll roads, allows for road user charging without needing to set up any gantries or additional elements.

Cintra, in collaboration with GMV, began to develop this app in order to provide a new way of electronic toll road charging. It also offers other information services

between road concessionaires and users, such as integration and validation of cooperative services C-ITS on a smartphone, doing so by means of mobile communications built into the vehicles' onboard units (OBUs), as an alternative to using V2X communications (ITS-G5). This means users can receive vital warnings of accidents and traffic conditions, etc.

This prize brings out the value of this toll-road information roll out, improving communications between road operators and users and speeding up and streamlining the electronic toll collection systems.



2nd Ecomobility forum on sustainable mobility in Castilla y León

In late May GMV took part in the sustainable mobility forum Ecomobility 2022, organized by the journal "El Norte de Castilla". GMV, one of the sponsors, also took part in the streamed discussion panel on the future of sustainable mobility.

Carlos Barredo, Automotive Aftermarket and R&D head of GMV's Intelligence Transport Systems sector joined other sector experts in this panel to debate the current state of mobility and the

upcoming challenges. Energy and sustainability are becoming increasingly important while still posing so many stiff challenges.

Carlos Barredo gave GMV's take on the future and most promising innovations of mobility services, in a context where the connected and autonomous vehicle is playing a key role in digitalization and sustainable mobility. GMV's main thrust here is based on satellite navigation,

where the firm boasts proven expertise in its ongoing use.

One of GMV's GNSS-based mobility trump cards is management and access to Low Emission Zones (LEZs), without ignoring cooperative C-ITS, whether with cellular C-V2X technology or DSRC/802.11p. These will allow use cases, such as those related to smart lane management and intersection priority, to be applied to urban transport sustainability and mobility.

GMV collaborates in a study on the feasibility of smart tachograph technology

■ The European Commission's Directorate General for Mobility and Transport (DG-MOVE) has published the study "TachogrApp – Feasibility study and cost analysis for developing a tachograph based on smart technology", drawn up by a consortium comprising VVA Group, GMV, Rapp Trans (DE) AG and RP Legal & Tax.

Tachographs fitted to freight vehicles play a crucial role in ensuring compliance with European rules on driving and rest times. This legislation aims to help preserve adequate working conditions and prevent distortions of competition between drivers from different regions and boost road safety, ensuring workers are in a proper state for driving their vehicles.

This study provides a first technical, legal and economic assessment of the possibility of improving current digital tachographs using the same

technology as smartphones, in order to maintain or improve the performance and security of current handhelds to ensure they meet the demanding conditions.

GMV's contribution to the study has focused on technical aspects, such as the possibility of using a connected device to watch out for compliance with current legislation and real-time detection and reporting of infractions. GMV also looked into the use of GNSS as main movement-detection sensor, security measures to guarantee information integrity and confidentiality in a connected and distributed system or management of remote device updating.

The study is not limited to technical aspects, however. Other partners have looked at the study's social, economic or legal factors; as such it will provide a complete base for discussion of possible tachograph upgrades within the European Union.

GMV at the 26th International Automobil-Elektronik Kongress 2022

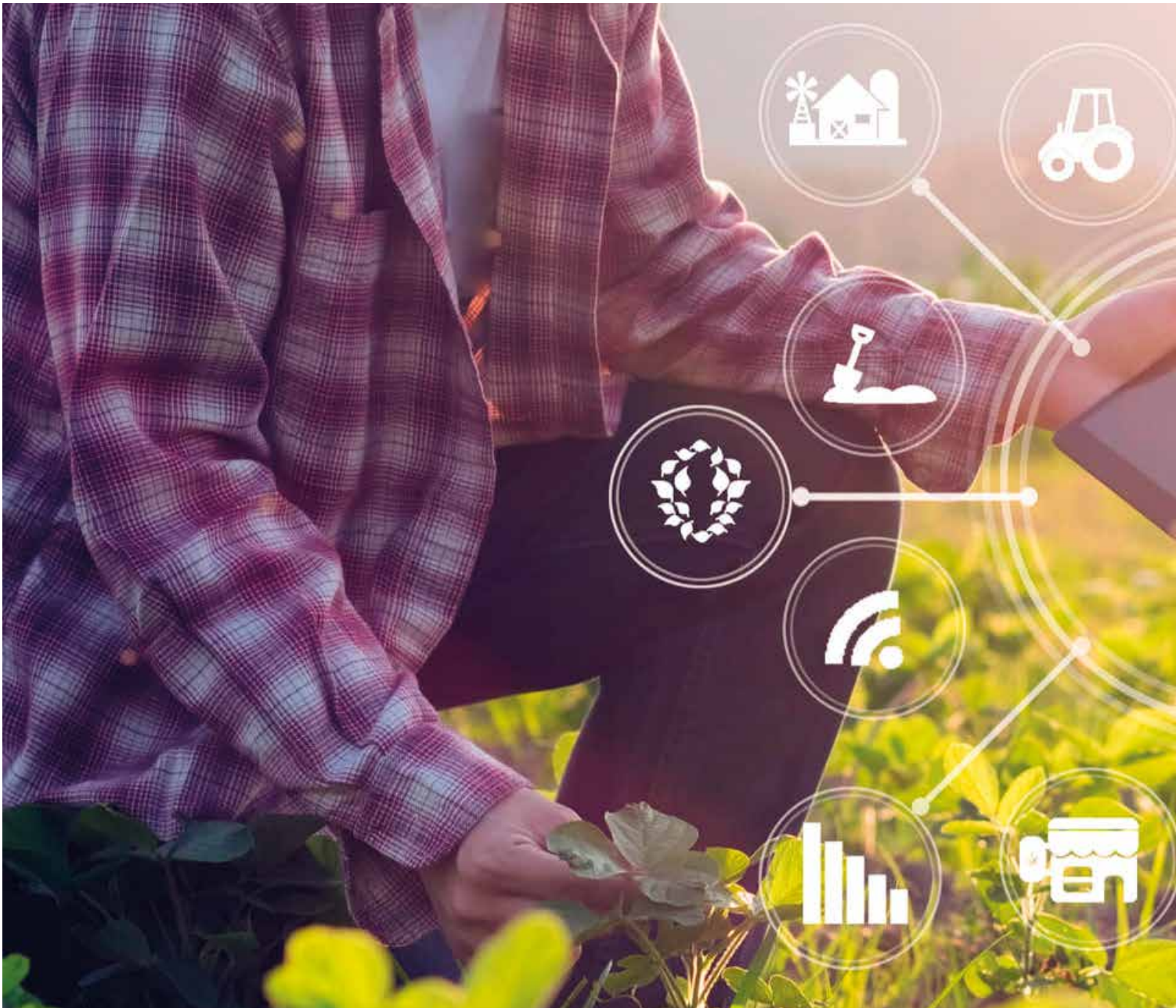
The International Automobil-Elektronik Kongress was held in the German city of Ludwigsburg on 28 and 29 June. GMV ran a stand to showcase its connected and autonomous vehicle products and services plus its vehicle security services.

The main theme of this trade fair is automotive electronics. GMV was thus able to explain its solutions to sector experts such as carmakers (OEMs) or international-level TIER I suppliers.

GMV takes part every year in fairs of this type, presenting its range of solutions by holding demos, participating in chats, showing videos, etc. Neither should the importance of networking be underestimated in encounters of this type, to find out what sector companies are demanding.

GMV has developed a wide range of automotive products, systems and services over almost 20 years, including positioning systems based on highly precise and secure GNSS systems for autonomous driving, connectivity services such as cooperative C-ITS, telematic services, advanced mobility, Road User Charging, eTolling or LEZ management. Our cybersecurity expertise also allows us to support our clients in ISO 21434 certification, conducting cybersecurity assessments and providing other CAV security hardening products.





Crop yield prediction using quantum computing

As part of the project AgrarIA, GMV is working on a proof of concept for agricultural crop yield prediction using quantum computing

Crop yield prediction, ensuring food supply, is vital for decision-making at a local, regional and national level. Estimates of the future yield of any cropfield help farmers make well-informed economic and managerial decisions while also helping countries in their ongoing efforts to combat hunger.

Under the AgrarIA project GMV is working on a proof of concept for crop yield forecasting using quantum computing. The aim of the pilot scheme, being run by GMV together with CSIC, is to process satellite images in order to develop a crop yield



predictor based on Quantum Machine Learning (QML).

This proof of concept will be performed on the basis of a preprocessed dataset of public satellite images to develop a QML-based predictor, with an assessment and interpretation of results so far. The forecasting model will also be enlarged to phase in other data: climate, multispectral image, risk data, etc.

"Within this process we will make comparisons between the forecasts obtained from quantum models and the state-of-the-art classic model. This will allow us to explore new ways

of incorporating image information into quantum algorithms as well as new quantum machine learning paradigms, while also analyzing the state of the art of AI in agriculture", explain Ángela Ribeiro and Juan José García Ripoll, CSIC researchers.

Farming is seeking a constant development of tools to help in crop management, favoring forecasts of weather conditions that might affect the crop, in order to phase in more efficient and better suited systems.

What is AgrarIA all about?

AgrarIA is a GMV-led project financed through the Artificial intelligence

R&D Missions Program of the Secretary of State for Digitalization and Artificial intelligence (SEDIA in Spanish initials) of the Ministry for Economic Affairs and the Digital Transformation, drawing on funds of Spain's Transformation, Resilience and Recovery plan. AgrarIA sets out to investigate the applicability and feasibility of artificial intelligence (AI), together with other industry 4.0 technologies. The overall idea is to come up with new farming production methods that will make Spain's farming practices more technological, groundbreaking and energy-efficient in the future with a reduced carbon footprint.

GMV applies PET technology to Earth Observation

■ Earth observation is crucial for describing the various phenomena occurring on our planet. A dramatic case in point was the eruption of the Cumbre Vieja volcano on the Canary island of La Palma. Here the images afforded by DRAGO, an infrared camera developed by the Astrophysics Institute of the Canaries and launched into space in early 2021, helped to monitor this earthly event.

In this context GMV, in collaboration with the European Space Agency (ESA), is participating in the MAZA project with a twofold goal. Firstly to identify and classify the soil as rural, residential or industrial. The land registry does make this distinction but it can all easily fall behind the times; there is therefore a need for an artificial intelligence model to help in these classification and updating tasks.

The project's second goal is to define the structure of the federated learning platform to enable the various stakeholders to set up a working framework with data both privacy-protected and available for algorithm training. This objective has been pursued on the strength of GMV's inhouse solution, **uTile PET** (Private-Enhancing Technologies).

uTile contribution to the Earth Observation field

Earth observation is carried out through the Sentinel-2 program, a fleet of satellites custom designed to provide abundant data and images to feed the European Commission's Copernicus program. Sentinel-2 images are public, open to any user.

When training up an AI algorithm, just as important as the data itself (in

this case images) is the associated metadata (which type of soil each image corresponds to). This metadata, known as labels in AI, is really costly to generate, and the data subjects are not always keen to share it. In other words, the images may be public but not the metadata.

Until the advent of **uTile** metadata owners were unable to tap into their opposite numbers' knowledge without a previous assignment (fairly unlikely, since this is precisely their core business). With **uTile** the image owners can allow algorithm training without sharing the images; data scientists can then develop and train the algorithms that will permit the extraction of insights from the original images; this knowledge can then be made available to final users.



Image taken by the Copernicus Sentinel-2 mission showing the lava flow caused by the Cumbre Vieja volcano eruption (Credit ESA/Copernicus/Sentinel 2021 - CC BY-SA IGO 3.0)

Predictive and operational 4.0 maintenance

Progress in technologies like 5G, artificial intelligence and machine learning enable us to control the information we generate and mine it systematically in order to change the way assets are supervised, maintained and optimized. True it is that the rate of digitalization is still patchy in industry, but it is no less true that there is no need to sensorize the whole plant to get the first results. We at GMV recommend starting by identifying the key components in which sensors will be fitted and from which data will be extracted, using techniques of predictive and operational techniques on said components, in order to improve and appreciably optimize plant production.

One of the first use cases we normally find in industrial plant is detection of anomalies in plant sensor data. This computational technique allows us to head off infrequent situations in the interests of predictive maintenance. The machine learning techniques most often used, however, cannot come up with an immediate response to this challenge. The problem here is that quality dataset is needed and it is hard to flag up anomalies beforehand when by definition they are usually unknown.

Data quality is another crucial factor for designing any data-based system. It is not just a question of compiling and storing sensor data; we also need to ensure that data to hand has sufficient information and contains no out-of-range variables. If we want to

obtain insights that are valuable for the organization concerned, we will have to ensure data quality, otherwise we stray into the classic error of "garbage in, garbage out".

What do we do when we have industrial process data but there is no recording of whether the plant was working in a nominal state or not?

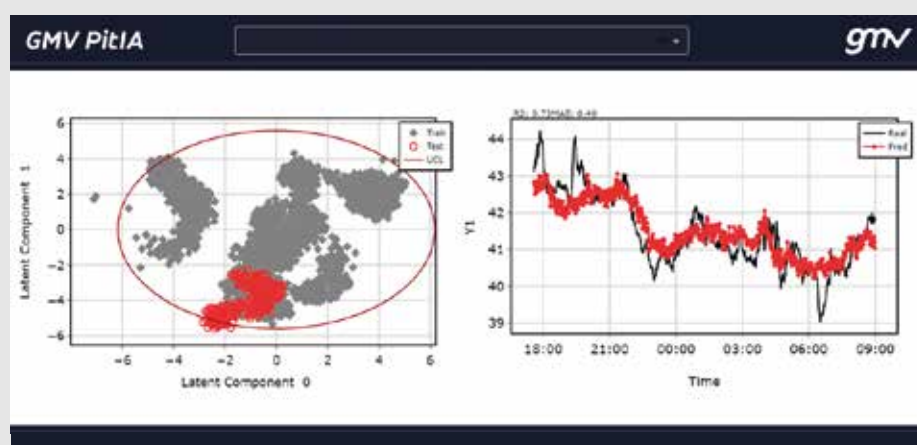
In these cases there are machine learning techniques that can help us identify the plant's nominal behavior pattern. Whenever we then see that the data generated by the plant's habitual activity strays from the previously learned pattern, we can infer that the plant is in an irregular state, i.e., we are dealing with an anomaly. The normal response is to want to know what is causing this plant anomaly. For that purpose GMV has developed the **PitIA** product, which, working work from all this information provided by latent variable models, can not only generate anomaly detection systems but also find out which element within the



José Carlos Baquero
Director of Artificial Intelligence & Big Data division
of GMV's Secure e-Solution sector

"An efficient predictive and operational maintenance of industrial assets is crucial for the organizations"

industrial process is causing said plant anomaly. All this information provided by **PitIA** is crucial for setting up an efficient predictive and operational maintenance of industrial assets.



GMV, a benchmark technology-transfer firm at TRANSFIERE 2022



■ For yet another year GMV has taken part in TRANSFIERE, the European Forum for Science, Technology and Innovation, which brings together the players capable of catapulting Spain from its current lowly ranking of 30th in the World Intellectual Property

Organization's Global Innovation Index to a place more worthy of its capabilities.

GMV was represented at the forum by Luis Fernando Álvarez-Gascón, general manager of GMV's Secure e-Solutions

sector, and Miguel Ángel Molina, GMV's manager of commercial development and strategy for space operations and ground segments, who participated in debating panels and specialist workshops.

Álvarez-Gascón took part in a think tank on specific innovation policies organized by the Forum of Innovating Firms (*Foro de Empresas Innovadoras*: FEI) and moderated by Francisco Marín, winner of the National Innovation Award 2020.

Miguel Ángel Molina, for his part, took part in the Boosting Zone initiative within the workshop "Access to international financing in Big Science and Aerospace" and presented the company, running through the main milestones of its 35+ years' track record. Thanks to GMV's work on numerous ESA space programs and European Commission projects, Galileo to the fore, GMV now ranks sixth in terms of employment and first among the MIDCAP segment.

The energy transition depends on data analysis, interconnection of the value chain and automation

The energy transition and digitalization were the core themes of the latest Breakfast-Colloquium "Transition towards a new, decarbonized, efficient and sustainable energy model" organized by enerTIC. GMV's manager of business development for the energy and utilities sector, Almudena Nieto, took part in the colloquium to urge application of technology and digitalization to ensure the energy efficiency and sustainability of this key sector of Spain's economy.

At these moments the energy sector has to cope with a perfect storm of high energy prices, changes in marketing models and the new EU agreements reached to lower electricity bills. In the

longer term it is also bound to tackle decarbonization of energy and lowering the carbon footprint.

Sector companies are faced with the energy transition (including electrification, the promotion of renewable energy sources), the technological revolution, and the transformation of companies. This obliges them to become more responsive and to adopt the technology most suited to find out the state of its assets and infrastructure and of its distribution networks, and to bring in renewable energy sources to help users save energy.

The main innovations pertain to predictive maintenance, data analysis and

real time data capture, asset monitoring and control, infrastructure and networks.

As for technology, special mention must go to digital twinning, which helps to model various future scenarios and speeds up implementation of initiatives in a real context. Other important factors are visualization of low-voltage distribution networks with artificial intelligence capabilities; digitalization of customer communications and the use of mobile apps; analysis of huge volumes of data using big data techniques; or sensorization projects with IoT technology and Edge Computing for control of scattered infrastructure.

Operational and predictive maintenance to drive industry

■ During the Trends Forum (Foro Tendencias) organized by enerTIC, José Carlos Baquero, GMV's manager of Artificial intelligence and Big Data, took part in the discussion panel "Digitalization and simulation of industrial processes: Predictive maintenance and other critical operations".

Implementation of groundbreaking solutions, with process digitalization to the fore, is key to cutting operating and production costs, achieving sustainability goals and consolidating the transformation towards Industry 5.0. Application of disruptive technology

to simulate critical operations, such as maintenance, is a factor sine qua non for achieving optimization of processes, resources and energy. Similarly, consumer needs are changing at breathtaking speed, keeping all companies on their toes to react in time. Here is where Artificial intelligence comes in, boosting the productive capacities of industries of this type and their efficiency.

In the industrial field, predictive models take in a series of statistical data-mining techniques, predictive modeling and machine learning to analyze trends and, without inducement, autonomously find

repetition patterns that help firms to anticipate future scenarios and make decisions such as risk assessment, detection of manufacturing anomalies or other operations of varied types.

GMV is working with technology of this type in all the following: detection of anomalies, flagging up where the problem is occurring; automatic quality-inspection tasks using artificial vision techniques; warehouse automation with autonomous robotics; collaborative robotics in laboratories; or the design of digital twins to understand plant behavior better and be able to train up machine learning models.

Digital twinning, IoT, AI or big data to favor energy efficiency in logistics and transport



■ Transport and logistics of large retail and distribution firms were the main topic of the latest enerTIC Breakfast-Colloquium.

Magda Andrés Barrios, Industry Business Developer Manager of GMV's Secure e-Solutions sector, took part in the colloquium to encourage application of technology and digitalization to the energy efficiency and sustainability of

the key sector of Spain's economy. Among all the technology now being used to cut energy consumption and make processes more efficient, stress was laid on sensor intelligence, IoT devices in combination with connectivity (5G), system integration and big data analytical tools.

Digital twinning came into the discussion for production and transport,

for creating models of production processes and obtaining mid-term synergies.

Advanced analytics is another option for the prediction of consumption, phasing in external factors and seeking patterns. Long gone are the days where it was fundamental to find out what had happened in the past. Today it is vital to know what will happen in the future.

Interview to Soledad Cardozo Salazar

International Strategic Partnerships Manager of the Spanish ACNUR Committee



ACNUR is leader and coordinator of the Regional Refugee Response Plan, with participation from UNPD, WHO, Save the Children, HelpAge International, INTERSOS, Project Hope, UNFPA, NRC, UNICEF, WFP and IOM. Together with its partners, it will carry out the following activities:

- IDP register
- Creation and management of transit centers
- Cash aid with multiple purposes
- Boosting capacity of community groups led by IDPs and war-affected populations
- Provision of legal assistance and psychosocial support
- Troubleshooting of the protection process
- Access to available information
- Pinpointing people with specific needs
- Support and provision of gender violence services
- Support/reinforcement of national child protection systems
- Legal assistance, consultancy, interpretation and representation, including asylum information
- Individual protection with cash aid for the most vulnerable.
- Management of individual cases and social assistance
- Psychosocial support for people with mental health problems arising from the conflict and displacement
- Reinforcement of the defense of access to territory, including alternative and temporary stay agreements and fair and rapid border procedures



ACNUR, The United Nations High Commissioner for Refugees, is working on the front line of those affected by the war in Ukraine. How has the situation developed since the onset on 24 February? What is the situation being lived through now?

Before the war started there were already 854,000 internally displaced persons (IDPs) in Ukraine due to the conflict that broke out in 2014. It is also estimated that, after nearly eight years of conflict, 2.9 million persons needed humanitarian aid in 2022, 55% of whom live in areas not controlled by the Ukrainian government. The provinces of Donetsk and Luhansk have been battlefields in recent years, with a profound knock-on effect on the life of millions of people. Since the start of hostilities in 2014, ACNUR has bent over backwards to bring help and protection to the affected people, providing articles of first necessity and refuge for the people forced to flee.

War was declared on 24 February, sparking off the current crisis, the quickest growing refugee crisis since World War II and catching all international actors on the wrong foot.

To date over 6.6 million persons have fled the country, seeking refuge in other countries, with an additional 8 million IDPs. This means over a quarter of the Ukrainian population have had to leave their homes, 90% of them women and children. Neither should we forget the c. 13 million persons trapped in war-affected zones without hope of escape due to the level of violence on roads and railways.

The situation is becoming more unstable, delicate and unpredictable by the day.

During this emergency situation in Ukraine ACNUR is giving protection and refuge to people affected by the war. It has also sent resources, personnel and emergency material. How many initiatives has ACNUR launched? To how many people has it been able to offer this humanitarian aid?



© UNHCR/Anton Fedorov

ACNUR, as the world's marquee organization for protecting refugees and IDPs, is also responsible for leading the response to the Ukraine conflict. It is a guarantor of international protection, always through the offices of its partners, humanitarian and local organizations. Its main task is to oversee and identify the refugees and IDPs' main needs, giving aid to suit.

ACNUR estimates that, as of today, 1.01 million persons have been helped directly; 196,769 of them have received protection and information at the various border-crossing points, transit areas and in reception centers. Cash aid has been given to 362,060; 450,000 have been given essential products like clothes, refuge materials and food. Humanitarian convoys, reaching the hardest hit areas, have helped 68,204. A total of 174 reception centers also offer 51,565 spaces for resting and sleeping.

Although much has been done, there is still a stiff task ahead in order to give help to everyone who is fleeing. ACNUR has therefore launched a worldwide plea for funds, achieving only 57% of its target sum to date. It is therefore essential for companies,

foundations, the civil society and individuals to pitch in.

The ACNUR company platform, still up and running, has raised nearly 500,000 euros by dint of over 100 challenges driven by companies like GMV. The whole company from top to bottom has done its bit to raise a sum of 41,765 euros. Which projects are these funds being spent on up to now?

ACNUR has been working in Ukraine for many years now giving protection, help and conducting refugee programs. There are currently 180 workers in Ukraine and 300 in neighboring countries and work is also underway with local authorities, the UN and other partners, to weigh up the situation and plan a response, minute by minute. ACNUR thus guarantees that humanitarian aid, possibilities permitting, is given wherever and whenever it is needed, while keeping up nonstop monitoring of Ukraine's borders with Poland, Romania, Moldavia, Slovakia and Hungary, in order to provide ongoing support in the reception of refugees.

Particular heed is paid to situations of extreme vulnerability such as the protection of children, especially

unaccompanied children who have become separated from their parents or guardians during the flight.

Spain's society, fortunately, has come to the aid of refugees in Ukraine like few other countries. Companies have set up various challenges through our platform, encouraging workers, partners and clients to join forces in an endeavor as worthy as the protection of the human rights of families that have lost everything. On the strength of these contributions we have been able to cover the most urgent health-, refuge-, food- and legal-needs of these families, among others.

Thanks to GMV's aid, for example, we have been able to provide 1000 plastic tarpaulins to help families protect their homes or refuge damaged by the bombing; 500 ten-liter cans of water to help them store and transport drinking water; 1000 woolen blankets as protection from the cold; 1000 personal-hygiene kits containing 1 toothbrush and toothpaste, 1 towel and 1 bar of soap; plus sleeping bags for 600 refugees fleeing Ukraine.

Many thanks to GMV and its employees for stepping up to the plate and helping the people who have had to flee this war.



GMV in Romania returns to a new office



■ The pandemic has been a turning point for everyone and after seeing that data has improved, GMV's subsidiary in Romania has decided to return in style to face-to-face work, opening its doors to an extended office and new state of the art facilities.

The offices are located on the 32nd floor of the Sky Tower, Romania's tallest building, and its inauguration was attended by Ignacio Ramos, GMV's Chief People Strategy & Infrastructure Officer. The updated workspace offers brand new facilities and a bigger

size that covers the entire floor for accommodating a larger workforce that in recent years has grown up to 60 employees, a trend which is expected to continue as the GMV business in Romania continues to expand.

The new facilities include a state-of-the-art laboratory fully equipped for avionics prototyping, space equipment and EGSE development, GNSS signal processing and simulation, and including as the center piece a modular ISO 7/8 cleanroom designed for integration and validation of flight equipment. It could be said that it is the tallest standing cleanroom in Europe.

The Ministry of Mobility and Transformation of the Junta de Castilla y León visits GMV's headquarters in Valladolid

■ On June 20, GMV received at its offices in Boecillo (Valladolid) the Minister of Mobility and Digital Transformation of the Junta de Castilla y León, Ms. María González Corral, the Director General of Transport and Logistics, Ms. Laura Paredes Aparicio, and the General Director of Telecommunications and Digital Administration, Mr. Antonio Ibáñez Pascual.

On behalf of GMV, Miguel Ángel Martínez Olagüe, General Manager of GMV's Intelligent Transport Systems, and Luis Fernando Álvarez-Gascón Pérez, General Manager of GMV's Secure e-Solutions, received the people who made up the delegation

from the Ministry and they offered a few words of welcome.

During the tour of the Boecillo offices, the validation environment for intelligent transport system projects for clients around the world was shown. These include the project developed for the light tramway in the city of Sydney (Australia), in which GMV supplies the fleet location and management system (SAE) and the passenger information system (SIU). In addition, they were given a tour of the office and the testing laboratories.

The development of GMV's high-precision positioning software for autonomous cars

was also presented during the visit.

Lastly, a live connection was made with GMV's CERT (Computer Emergency Response Team). Patricia Tejada, director of Digital Public Services at GMV's Secure e-Solutions, and Óscar Riaño, head of GMV's CERT, explained the start-up and operation of cyber protection infrastructures, as well as the response to incidents through GMV's CERT.

For GMV, this visit is a great opportunity to show part of the industrial and technological activity carried out at the Boecillo headquarters.

GMV joins the "Um dia de Caminho" project

■ Training attuned to present-day needs is one of the cornerstones of employability and a person's potential to enter the job market and maintain a stable job over time.

Technology companies like GMV require specialized and up-to-date knowledge of the most advanced technologies, which is why it collaborates with various initiatives that aim to narrow

the gap between academia and the professional world and promote training that allow different groups to find their place in today's and tomorrow's labor market.

To promote high-quality, stable employment for young people, GMV joined the "Um dia de Caminho" program, a project fostering interactions between high school students nearing graduation

and various companies in the industries identified by students as the most appealing for developing their future careers.

Within the framework of this project, on April 20, a group of students from Colegio São José Ramalhão visited the company's Lisbon facilities to learn more about what it's like to work in the aerospace industry.

SOS ARCTIC 2022 now underway

■ On May 19, the SOS ARCTIC 2022 expedition began its route across the southern Greenland glacier. After 10 days of extreme adverse wind conditions delaying the expedition, the team members gathered at the starting point at the foot of Nunatak in Sermersooq at an altitude of 2,396 meters, after a helicopter ride from the base in Narsarsuaq, a small town in southern Greenland. The expedition will traverse Greenland from west to east, covering 1,500 kilometers of unexplored terrain.

The six expeditioners involved in SOS ARCTIC 2022 are traveling on board the polar Wind Sled on a mission to conduct two scientific experiments. Microairpolar-2, run by the Universidad Autónoma de Madrid, will study the geographical distribution of microorganisms in the air, their ability to stay alive and the impact that the melting of the poles may have on them. Meanwhile, SOLID (Signs Of Life Detector) is an instrument that the Centre for Astrobiology (INTA-CSIC) will test and fine-tune in this analogous

terrain, for later use in the detection of signs or traces of life in other parts of the solar system, such as Mars. Both experiments are coordinated by the mission's chief scientist, Lucía Hortal.

This project has been made possible thanks to the support of GMV, among other collaborators, which, true to its commitment to science and innovation, wanted to join this pioneering adventure. Don't miss the expedition updates on our social media.



GMV celebrates UPMday22

■ On 17 and 18 May Madrid Polytechnic University (Universidad Politécnica de Madrid: UPM) held its diploma-giving ceremony, UPMday22, bringing together 15,000 graduates of its 16 schools in 2019-2020 and 2020-2021.

After two years of COVID-19 constraints, UPM chose Wanda Metropolitano's Madrid site to receive these new graduates in engineering and architecture. The event also included the solemn investiture ceremony of UPM's new doctors, the handover of the Extraordinary Doctorate Prizes and the graduation of students of Sciences of Physical

Activity and Sport and Fashion Design.

GMV was present on both days of the event. Ignacio Ramos, corporate manager of GMV's People Strategy & Infrastructure, handed out the prizes to the best-performing graduates from academic years 2019/2020 and 2020/2021 in aerospace-engineering, in the specialism of aerospace technology and sciences and in computer engineering, as well as to two first-year students of the university MSc in aeronautics engineering, and to one second-year student in this same qualification. This recognition is part and parcel

of the ongoing agreement between GMV and UPM under the Cátedra GMV arrangement.

Furthermore, with the aim of closing the gap between academia and business, UPMday22 also showcased the current job opportunities. GMV, ever keen to nurture and promote budding talent, explained GMV's business projects to recent graduates and broke down current job vacancies by skillsets and preferences. It also featured prominently in various business chats for graduates on the company's space, GNSS, defense, cybersecurity, IoT and industrial-robotics projects.

GMV steps up its sustainability commitment with several voluntary environmental activities

■ June 5 was World Environment Day, a day set aside to raise awareness and remind people of the importance of fighting against the environmental damage being caused by human activity and our current lifestyles. This year the United Nations Environment Program (UNEP) has set in motion the campaign #OnlyOneEarth to urge society to combat global warming, pollution and habitat-degradation of endangered species.

As part of GMV's ongoing commitment to sustainability, and in keeping with the main principles of its environment policy, the company is keen to drive change. To celebrate this day GMV personnel in its Lisbon office (Portugal), together with their families, took part in an organized beach cleanup at Inatel in São João da Caparica. Under the guidance of environmental specialists from the City Council of Almada, the volunteers spent the morning of 4 June clearing an invasive and future-threatening

grass species from the crucial dune system, home to a rich autochthonous flora and fauna.

Initiatives of this sort are not one-offs; GMV's commitment is a year round thing. In April, for example, GMV personnel in several different offices around the world joined forces with local initiatives. Los Angeles supported the work being carried out by the association FOLAR (Friends of the LA River), which sets out to preserve the environment of the Los Angeles river, the main urban alluvial flow of this region. Under FOLAR's initiative "Earth Week CleanUps 2022" GMV colleagues managed to remove over 45 kg of trash from the river. Funds were also earmarked to collaborate with FOLAR's objectives of keeping this area salubrious and encouraging its climate resilience.

In Houston (Texas) GMV joined in an environmental conservation initiative in the Spring Creek nature reserve, helping to remove invasive plant

species from the nature reserve that is home to a wide range of flora and fauna. It is also an environmental education center for the local community.

In Madrid a team from the Tres Cantos office collaborated with the Reforesta association on forestry preservation work. Our colleagues traveled to the Valle de La Barranca in the Madrid mountain range called Sierra de Guadarrama to help in setting up personal protection and plant autochthonous species to preserve this ecosystem, hard hit by centuries of over-pasturing, felling and charcoal making.

Protection and conservation of the environment, cooperation in organized action to achieve this protection and promotion of a sense of responsibility at all levels: these are the mainstays of GMV's environmental policy and the lines it is working on to encourage sustainability in the environment that surrounds its colleagues every day.

GMV helps female talent to find its feet



■ STEM Talent Girl 2021/2022 culminated on 21 May in a closing ceremony in the congress hall called Palacio de Congresos Conde Ansúrez in Valladolid (Spain). This initiative, brokered by Fundación ASTI, is a feet-finding program to encourage girls

from the last years of secondary and baccalaureate education and female undergraduates to aim at STEM careers.

Fundación ASTI and the Regional Ministry for the Family and Equal Opportunities of Castilla y León

organized this event, with diplomas being handed out to the young female students and pupils who have taken part in this sixth STEM Talent Girl. GMV has once more collaborated in this initiative, organizing mentoring sessions, chats and master classes to encourage the young girls participating in this program to take up scientific-technological careers, inspired by the experience and expertise of our GMV colleagues.

GMV, together with the other firms collaborating in this program, received the STEM Talent Girl seal in proof of its ongoing commitment to STEM education.

Boomerang employees: when values come first

The so-called emotional salary plays a key role in people's decision to return to the companies they once worked for

A person may decide to leave a company for several reasons, but there are also several reasons why they decide to return; and this is where GMV values and "emotional salary" play a key role in the decision.

Boomerang employees are those who decide to return to the company they

were once part of after having left for a period of time. The opportunity to go back to the company whose corporate identity you relate to is something that is priced at a premium, as this way the uncertainty experienced about changing companies is highly mitigated. Furthermore, besides from being very beneficial to individuals, it is also beneficial for companies; since

the person already knows something about the organization and its culture and the time for them to adapt is shorter. This adds value from minute 0.

In this issue, we share the experiences of two people who, for various reasons, were away from GMV for a period of time.



Miguel Russián Rojas

Cybersecurity Engineer



I always wanted to study abroad, especially at an internationally recognized university such as KU Leuven in Belgium. It was even more interesting to be able to approach future academic challenges from a professional perspective, generating ideas that I could then take back to industry. In addition to being able to learn from important researchers in the sector, I was looking for other ways of thinking and working, which is valuable in a sector that is constantly being renewed and is increasingly cross-sectoral, such as the technology sector.

During my stay I was also able to learn more about the relationship between research and business—initially a gap that was quite evident

in Spain—which was more apparent in the testimonies of colleagues and professors from my Master's degree. It was an interesting learning experience, because exchanging perspectives and knowledge brings us closer to the technological forefront, facilitating new developments to take advantage of.

After finishing my Master's degree, I had many reasons to return to Madrid, and to GMV in particular. In terms of work, GMV is a company with a range of services that is constantly growing. It serves important clients from all kinds of sectors. On the other hand, it offers very good working conditions, which improved even when I was gone. All this made going back to GMV a natural decision for me.

David Lora López

Business Partner in the financial sector



Along our path in our professional life, we make decisions that we believe are the right ones, and when faced with a good opportunity, you can't let it pass. A few years ago, my role within GMV was not aligned with what I had envisioned for my future; my goals and objectives were different. And with chance and circumstance hand in hand, the day came when I wrote the difficult farewell email, starting on another road that lasted a couple of years outside GMV. It was the most complex and difficult decision I have ever had to make in my career.

Being outside the company for a period of time helps you have perspective of other areas and ways of working. You learn methodologies, make other contacts and get to know other work cultures. It's a constant learning, and you consistently compare it with your previous stage. I have since tried to combine this knowledge with the skills I already had.

In the end we all play a leading role in almost everything that happens to us in life; we are the result of who we spend the most time with, and that was my main reason and motivation for coming back to GMV. Above all, it was because of GMV's DNA and the people with whom I have always kept in touch with and who make this company special. I never considered that going back was a step backwards. You shouldn't have regrets about your big decisions.

I also want to grow and contribute as much as possible, where seeking a win-win situation for all parties is a mutual obligation, with the responsibility, commitment and motivation that I have always been able to bring to GMV, and thus take up again the path I started out on many years ago, but with strengthened motivation and renewed objectives. And here I am back.

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