



The new military aeronautics programs, key factors in Europe's C21st sovereignty



INTERVIEW

Javier Salto Martínez-Avial

Airforce Chief of Staff (*Jefe de Estado Mayor del Ejército del Aire: JEMA*)



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The international Smart City Congress is to be held for the fifth time this year from 19 to 21 November. Every year it attracts the sector's top national and international representatives, researchers, academics, investors and corporations.

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Letter from the president

The car of the future according to BMW will be electric, connected and autonomous. Its safety will depend on precise and reliable positioning. BMW has thus decided to entrust the development of its future cars' positioning systems to a leading company in satellite-based positioning systems, a company that is also expert in cybersecurity and which has a tried-and-tested track record in the development of solutions for the automotive industry: GMV.

Drawing on its plentiful experience built up in other sectors with strict certification requirements, like aviation, GMV has been able to develop for this project a cast-iron validation methodology for the positioning system's safety and integrity. The difference is that the number of obstacles

to be skirted on the road is much greater than in the air. This means the positioning-safety and -integrity requirements for autonomous driving taken on by GMV are even more demanding than in aviation.

As well as more precise and trustworthy positioning technology, autonomous cars call for new developments in sensors, big data technology, connectivity, cybersecurity and artificial intelligence. This technology has a huge potential in many different ambits, with obvious applications in the military arena as well. The military aeronautics program FCAS, in which Germany, France and Spain are all collaborating with a heavy outlay, is an essential step towards the development of these new capabilities in which Europe cannot afford to lag behind.

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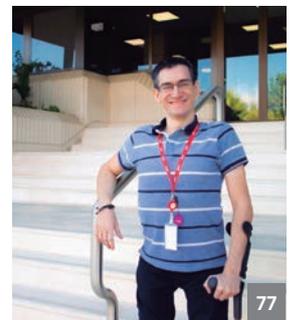
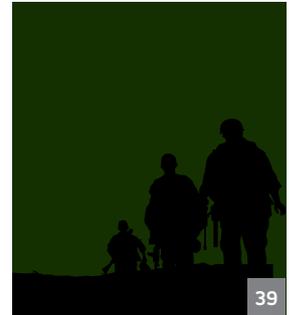
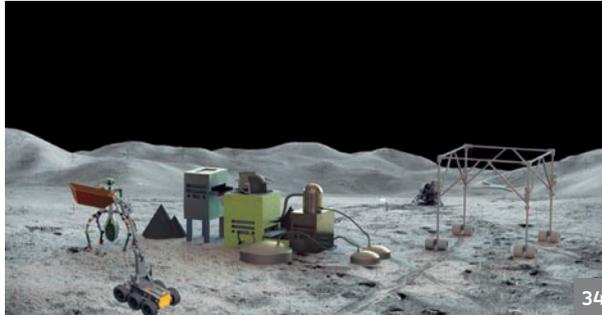
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The new military aeronautics programs, key factors in Europe's C21st sovereignty

The new military aeronautics programs: FCAS, EuroDrone, ITS

On 17 June Spain's Minister of Defense, Margarita Robles, together with her opposite numbers from France and Germany, Florence Parly and Ursula von der Lyen, signed Spain's membership of the Future Combat Air System (FCAS). Although FCAS looks set to be Europe's prime military aeronautics program of the coming years, it is not the only one. Also in the pipeline is Europe's remotely piloted aircraft EuroDrone. At national level work is underway on a new Integrated Training System (ITS), to replace the historical Casa C-101 and Northrop F-5M, plus a new version of the tactical RPAS ATLANTE.

The FCAS/NGWS Program

The FCAS program represents an ambitious upgrade of the Eurofighter program, both at technical and international-cooperation level.

The overarching FCAS concept is that of a system of systems incorporating a large array of both crewed and uncrewed aerial platforms plus land-, sea- and space-systems. This concept calls for the development of a Next Generation Weapon System (NGWS). The overall FCAS vision also includes systems now in production phase (and likely to need modernization to guarantee hallmark FCAS interoperability levels) and even joint operations with other allied forces.

The NGWS project is currently underway between France and Germany, where the initial industrial contracts have already been drawn up. The first phase, now in development between these two countries, is a Joint Concept Study (JCS), based on High Level Common Operational Requirements Document (HLCORD), signed between France and Germany in April 2018. From the industrial point of view the study is being led by Dassault Aviation and Airbus Defence and Space, with the participation of other French and German firms like Diehl, ESG, Hensoldt, MBDA Systems, MTU, Rohde&Schwarz, Safran and Thales. This project ends in 2020, and Spain's industry is set to take part after the



abovementioned signing of Spain's FCAS membership.

At the same time the French and German industries have now defined for their governments how they should tackle the development of a first phase of technology demonstrators for studying the necessary groundbreaking NGWS-implementing technology. The agreement signed between France, Germany and Spain establishes Spain's intention of achieving a 33% participation in the various technology demonstrators that have been identified, including:

- A future sixth-generation jet fighter called Next Generation Fighter (NGF). Although the sixth-generation concept has not yet been perfectly defined, it includes such aspects as very low observability and camouflage possibilities. Other features are high efficiency in all flight regimes in which the aircraft operates, both from the aerodynamics point of view and the propulsion system, the ability to operate with uncrewed combat aircraft and radical improvements in all guidance and navigation systems, protection systems, decision-making aids, arms and materials systems, etc.
- A series of uncrewed vehicles called "Remote Carriers", with ISTAR (Intelligence, Surveillance, Target

Acquisition and Reconnaissance) observation and combat capability, acting in liaison with the NGF.

- State-of-the-art sensors, since sixth-generation systems of systems (SoSs) such as FCAS/NGWS incorporate yet more varied and powerful sensors in the diverse component platforms. Incorporation of these sensors will have significant implications from the point of view of connectivity, distributed processing and pilot interaction. The ongoing development of technology in these areas will hence have a big say in exactly what happens with the sensors.
- Adaptive cycle engine technology with low electromagnetic signature and smart maintenance.
- A powerful simulation environment and tests to try out the various concepts and components to be developed.
- Low-observability technology to fit in with sixth-generation fighter requirements.
- A cloud combat network with a scalable system architecture implementing and guaranteeing full connectivity of the FCAS system of systems. This will ensure a common operational vision shared by all stakeholders and providing each one with the necessary decision-making aids.

The NGWS will incorporate completely groundbreaking technology in terms of military avionics, communications, mission management, etc.; as well as

many other fields straying outside GMV's normal range of activities, such as aerodynamics, structures, manufacture, engines, etc. Zooming in on the technical areas closest to GMV's activity, some of the most significant of these new technological developments will occur in the following fields:

Computing. This technical area is considered to include all hardware and software technology to meet all FCAS/NGWS crewed or uncrewed components' onboard processing needs. It therefore takes in all technology trends in terms of architecture or advanced hardware technology (e.g. multicore processors, quantum computers, neuromorphic computing), network architecture (e.g. distributed computing, including cloud and edge computing) or software architecture like Integrated Modular Avionics (IMA). Computing technology is a fundamental enabler for onboard implementation of diverse platforms in the FCAS/NGWS.

Autonomy. This technical area includes all technology required for achieving the degree of autonomy needed by FCAS/NGWS platforms to fulfil the system operations concept. It hence takes in all technology to do with artificial intelligence, cooperative automatic operation (swarming) among the system's crewed or uncrewed platforms, pilot-machine collaboration or positioning, navigation and timing between the various aircraft making up the



system. In upcoming years advances in onboard computing are likely to boost autonomy well above current levels, reaching level E4, i.e., goal-oriented autonomous operations and not only in events. From the point of view of onboard systems the key factor for widespread take-up of this type of combat aircraft systems will be software development and certification. In the medium term increasing knowledge of the safety of software systems, either by using super scenarios exceeding the operating envelope of systems of systems (in our case of FCAS/NGWS) or by means of statistical model checking, will facilitate the certification process of onboard autonomous systems of this type for use in critical functions. It is particularly worthy of note here that GMV has already shown advanced autonomy capabilities in the space sector, where the company now boasts a leading position.

In the mid-term too autonomy systems will employ some type of artificial intelligence (AI) technology. Even more likely is that future onboard systems will use a shared training model. Although this technology will not be sufficiently mature in the mid-term for critical flight systems, it could still be phased into mission systems within this period.

As for navigation systems, Galileo's restricted access signal will be available as from the start of the next decade and it will have to be considered, as from that date, as a fundamental information source for all position- and timing-dependent functions in future European air combat systems. Galileo's Public Regulated Service (PRS), however, will not replace the North American GPS but will rather coexist with Galileo block III M code.

The range of necessary technology for reaching the required level of autonomy in the various components under their diverse modes of operation is very broad, taking in very diverse disciplines.

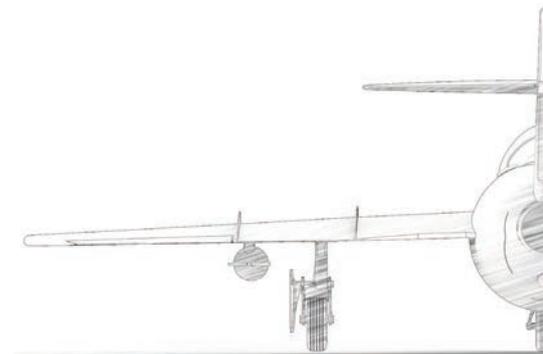


Human-machine interface.

This technical area comprises all technology to do with the way in which the platforms, especially NGF, will interact with their human operator, i.e. with their pilot. It therefore takes in technology pertaining to all the following: person-system integration, the presentation of information of varied types to the pilot, including both hardware devices and mixed software technology; the increase of pilot capacities to facilitate mission control and the wearable or haptic devices.

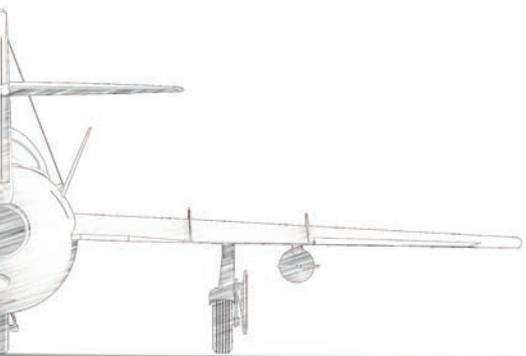
The evolution of technology in this area is necessarily tied in with parallel developments in other technology. For example, any computing and artificial-intelligence advances might substantially modify the

pilot's way of interacting with the system. Technology like virtual personal assistants depend greatly on advances in other fields like artificial intelligence for the development and implementation, for example, of natural language interfaces. To take another example of interdependency,





the evolution of sensor technology might enable the development of new technology for commanding the different aircraft systems by way of gestures. In the longer term consideration will also have to be given to the introduction of virtual reality (VR) and augmented reality



(AR) technology, especially in the pilot-aircraft interface.

Connectivity. Into this technical area fits all those technologies that facilitate permanent, reliable and secure interconnection between the various FCAS/NGWS components and internally within each one of the components. This takes in a wide range of technology including developments to do with the Internet of Things (IoT), with broadband communications of various types of physical support (e.g. fiber optic, laser, cable) or with cybersecurity in hyper-connected environments. FCAS/NGWS connectivity demands will be very high, both internally within each platform, within the system or beyond system limits to take in external command and control environments.

Advances in the aforementioned technology are a fundamental enabler for the FCAS/NGWS concept.

From the cybersecurity point of view Trusted Platform Module (TPM) technology will be used for identification, authentication, enciphering and verification of the integrity of the aircraft's onboard devices, as an additional safety measure. Physically Unclonable Functions (PUF) will also be used to avoid the introduction of system-jeopardizing false components in the onboard equipment.

Sensors. The FCAS/NGWS system and the component crewed platforms will have a substantial load of sensors of all types. The associated technology for this area comprises not only the necessary technology for sensor development and construction within the whole radio electric spectrum but also for management and processing of the data generated by these sensors in real time as well as for extraction of pilot-actionable information, i.e. for data fusion or, in a broader sense, for data analysis or Big Data. As in other aforementioned areas, this includes not only hardware technology but also software technology. Neither can it be isolated hermetically from technological trends in other areas like computing or artificial intelligence, which may be basic enablers for this technology.

This area also includes the necessary technology for capturing data on the state of the systems themselves. This technology can facilitate the phasing in of capabilities like inflight platform reconfiguration or the necessary logistical support processes to maximize system operability.

In the future, multi- or hyper-spectral sensors could replace the electro-optical sensors used by today's fighters; this will depend largely on the available onboard computing capacity for processing the sensor data.

Data fusion techniques, essential for presenting actionable information to

the pilot, will progress to incorporate Bayesian networks and, above all, to enable implementation of Explainable AI systems, so they could then be used to boost aircraft autonomy for attack missions, practically leaving the pilot the final decision (Go /No Go) for ethical reasons.

Navigation by artificial vision will also be possible, based on optical or hyper-spectral sensors, which could be used for mission-related or aircraft-safety functions, lightening the pilot's load in UAV swarm environments, such as Sense and Avoid (SAA).

The increase in processing load, due to the higher number and greater complexity of onboard sensors and better connectivity between the aircraft and other platforms, could lead to implementation of distributed computing schemes for data processing, likely to be underpinned by some form of middleware similar to DDS (Data Distribution Service), suitably cleared for onboard use.

Mission management. This technical area comprises technology related to the preparation of system missions, the distribution of roles for each mission and their dynamic configuration, plus the generation and assessment of operational alternatives for mission execution. It hence includes constructive simulation technology or other trends like digital twinning.

Technology of this type will probably be distributed between flight platforms and ground support systems. It seems likely that, for reasons of latency and onboard computing capacity, the onboard systems will be restricted to assessing variations on a nominal scenario comparing alternatives against predefined patterns. But this would in turn depend on advances in computing, data analysis and AI capacity. It cannot be ruled out a priori that mission management would be carried out completely autonomously by onboard systems.

The EuroDrone Program, the European MALE

The EuroDrone program for development of a European Medium Altitude Long Endurance (MALE) Remotely Piloted Aircraft System (RPAS) is being led by Airbus Defence and Space GmbH (Germany, with a 31% participation) and their strategic partners are Dassault Aviation (France, 23%), Leonardo (Italy, 23%) and Airbus Defence and Spain (23%). After a definition phase beginning in 2016 and ending in November 2018, in late May 2019 these firms presented a bid for development, manufacture and production in operating conditions to OCCAR, the organization that the participating nations have entrusted program management to. The contract is now expected to be signed soon, with subsequent participation, inevitably, not only by these project-spearheading firms but

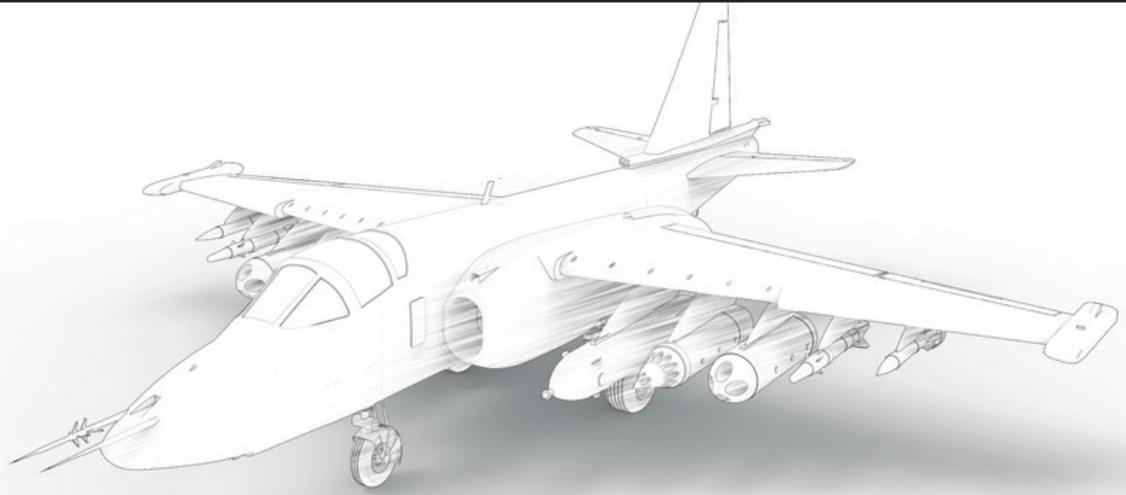
also the rest of Europe's aeronautics industry.

The EuroDrone, with twin turboprops, an autonomy of over 24 hours, wingspan of 26 meters, fuselage length of 16 meters and maximum weight of about 11 tons, is due to take its maiden flight by 2024. If this deadline is met, production units will start to be delivered by 2026. The initial 4-country contract could run to 63 aircraft with their ground stations (2 ground stations for every 3 aircraft). It should of course be interoperable with other RPASs like America's Reaper or Israel's Heron.

With the development of EuroDrone, Europe will cater for a capability considered to be strategically important, endowing it with sovereignty in this area. It is conceived as a very flexible, multi-mission system that can be tailored to suit a very varied range of military and security environments. Missions will therefore be surveillance in type, both sea and land, support for military and security operations, ISTAR (Intelligence, Surveillance, Target Acquisition and Reconnaissance) and its integration in C4I systems. There are even future plans for development of an armed version. It is also intended to obtain both military and civil clearance for its insertion in the commercial airspace conceded by the European Union Aviation Safety Agency (EASA).

The EuroDrone program is planned to be very low technological risk, thereby





minimizing developments. Recourse is also made wherever possible to off-the-shelf solutions for each one of its components. Nonetheless, there is a series of critical elements that are understood to call for special treatment: the whole guidance, navigation and control system including the automatic takeoff and landing system (ATOL), mission software adapted to necessary interoperability standards and equipment like sensors or communications devices.

The ITS Program, the new Trainer Aircraft

The training and flight instruction of a fighter pilot has to pass through various stages. There is a first elementary stage that, in the case of the Spanish airforce, is carried out with the T-35 Pillán aircraft. This first stage is followed by a basic course conducted with the CASA C-101; finally, training is completed with an advanced specialized fighter course

with the Northrop F-5M. Both the CASA C-101 and the Northrop F-5M are aircraft approaching the end of their useful lives, so their replacement in the next few years is essential for the airforce.

Airbus Defence and Space Spain, as leader of a consortium pooling the rest of Spain's aeronautics industry, has proposed to the Spanish MoD and airforce that a new trainer be developed from the C-101, catering for basic and advanced training stages including, in its most advanced configuration, ground attack and combat. It would be a two-person aircraft (learner and instructor), swept wing with a low bypass turbofan engine and capable of transonic and supersonic flight.

This proposed development program for the new trainer aircraft would cover all needs posed by the Spanish airforce, with an operating envelope totally in keeping with its requirements. It also offers significant advantages, in terms of industrial aspects, autonomy and national sovereignty. It would also ensure maintenance of Spain's current capability, shared by few other countries, of developing a complete aircraft. Finally, it would represent a huge boost for Spain's national aeronautics industry,

for example for the new FCAS/NGWS program, together with which this system is planned to serve as the training base for the new NGF.

GMV's position

GMV, as a leading aerospace company, is well positioned in all these aeronautics programs to win a significant participation in areas where it boasts a tried-and-tested expertise, such as:

- Robust navigation systems, flight control systems (Flight Control Computer) and automatic takeoff and landing (ATOL) systems for uncrewed aircraft.
- Systems where new autonomy and AI concepts are applicable, in particular:
 - Extended Tactical Situational Awareness System (EXTASYS).
 - Digital pilot assistance (AI).
 - Mission systems.
- The supply of tools and services of development, validation and certification of onboard software, including the DAL-A-certified XKY operating system and its associated tools.
- The supply of ground support systems both for crewed and uncrewed vehicles for their integration and operability with C4ISR networks.
- Cross-the-board cybersecurity technology under standard RTCA DO-326A.

GMV is keen to take on all the thrilling challenges posed by the future aeronautics programs, in which it is set to play a key role and thus continue its long track record as sector leader.





Javier Salto Martínez-Avial

Airforce Chief of Staff (*Jefe de Estado Mayor del Ejército del Aire: JEMA*)

Javier Salto, born in Madrid in 1955, was part of the 30th graduation year from the General Academy of the Airforce (*Academia General del Ejército del Aire*), joining the airforce with the rank of Lieutenant in 1978.

His first operational post came in 1979 with Squadron 464 of Gando Airbase, where he flew the F-5A aircraft. From 1981 to 1993 he was pilot instructor on the Mirage F1 (462 Squadron).

In 1993 he took the Air Force General Staff Course at the United States Airforce's Air Command and Staff College (ACSC) on Maxwell Air Force Base (USA).

In 1994 he graduated with the General Staff diploma and was assigned to the General Staff at the Canary Islands Air Command Headquarters. In 1995 he was posted for six months to NATO Headquarters in Naples AIRSOUTH.

In 1997 he was assigned to the NATO Eurofighter and Tornado Management Agency (NETMA) in the German city of Munich for three years as a specialist in operational factors for the Eurofighter 2000 programme. Three years later he was posted to the EF2000 Programme Office at the Spanish Airforce Logistic Support Command (MALOG in Spanish initials).

After promotion to the rank of Colonel in June 2003, he was appointed Commander of the 11th Wing and of Moron Airbase, holding the post for three years during which he piloted the EF2000.

In 2006 he was appointed Director of Operations at the NATO Combined Air Operations Centre No. 8 (CAOC 8). In November 2008 he was promoted to the rank of Brigadier General and appointed Deputy Director of Material Management at MALOG. In December 2009 he became Head of the EF2000 Programme and Spanish Representative on the Programme's Steering Committee.

In January 2011 he was promoted to the rank of Major General, and appointed Director of Weapons Systems at MALOG, becoming the Spanish Representative for the A400 Programme Steering Committee, while remaining Spanish Representative on the EF2000 Programme's Steering Committee.

In June 2012 he was made Chief of the Canary Islands Air Command (*Mando Aéreo de Canarias: MACAN*).

In June 2015 he was promoted to Lieutenant General and appointed Director of the Executive Office of the Minister of Defense.

In March 2017 he became Chief of Staff of the Spanish Airforce.

Throughout his career he has built up over 3000 flight hours on a varied range of aircraft (F-5A, Mirage F1 and Eurofighter, among others).

Airforce General Salto has been awarded various decorations, both at home and abroad.

From the systems viewpoint which are the Spanish airforce's most pressing needs and what will its short- and medium-term priorities be?

As of today the Spanish airforce's most pressing need to keep up its present capabilities and recover those recently lost as a result of the economic downturn.

In relation to its main capabilities the airforce's backbone is and will continue to be its Air Control and Command System (*Sistema de Mando y Control Aéreo*) and its associated arms systems. These all help to guarantee fulfilment of our main mission and are our most decisive contribution to joint action, so they should obviously be the top priority in resource management. At the same time we have to continue to improve our expeditionary capability and maintain the systems that will enable us to perform the missions allocated to us under the State Aerospace Action Plan (*Plan de Acción Aeroespacial del Estado*).

As regards systems, the short-term priority is to replace the basic training C-101 aircraft of the General Air Academy. The aim here is threefold: to keep up the training of the pilots needed by the

Spanish Airforce (whose contracting process is already underway), renew the F-18A of the Canary Island Air Defense and modernize the command and control systems.

To this must be added the phasing in of the new undertakings that in turn entail new capabilities and systems, such as employment of Predator-B as the Spanish armed force's first ever strategic RPAS and the creation of the Space Surveillance Operations Center (*Centro de Operaciones de Vigilancia Espacial: COVE*), which increases Spain's outer-space control and surveillance responsibility.

In the short term we also have to continue to phase in the Airbus A400M transport aircraft and prepare ourselves for the arrival of the NH-90 helicopters, of which we will soon begin to receive the first units.

A medium-term need is to replace a large part of the aircraft fleets, especially the F-18M, the maritime-patrol and surveillance aircraft (P-3 and CN-235 VIGMA) and the training aircraft T-35 Pillán and F-5.

Thirty years ago now Spain's participation in the Eurofighter

program meant it had to knit together the national aeronautics fabric. What might be the knock-on effect of Spain's recent joining of the Future Combat Air System (FCAS) for its airforce and also for the whole industry?

For the airforce it entails acquiring the necessary capabilities for addressing the future scenarios. Studies have been conducted on what the future operation theaters will be like and which will be the missions carried out. These studies show the need to build up new capabilities to match new technological developments. The airforce should be spearheading this technological leap to maintain superiority in tackling possible threats. The Next Generation Weapon System (NGWS) project, under the umbrella FCAS concept, will enable us to work jointly with our main European allies in acquiring these capabilities.

For Spain's national aerospace industry, which currently accounts for 80% of the whole defense activity, it implies maintenance of the aeronautical leadership built up over recent years with programs like Eurofighter and A-400M. The participation of Spain's industry will be key features in cementing its capacity and generating the necessary industrial fabric for taking on the industrial challenges of the coming decades.

What opportunities and challenges does Spain's participation in this program open up for the industry? Do you believe the country's industrial fabric has the sufficient technical capability for meeting its needs?

The NGWS project poses huge technological challenges that few countries are capable of. But I believe Spain's industry is well placed to meet them, not only in terms of the technical level built up during its participation in past programs but also the skillsets and readiness of our professionals.

In your opinion which are the new technologies that have to be incorporated into the NGWS to develop and even improve the Eurofighter, an outstanding combat



aircraft that would still seem to have some way to go before becoming operational?

Indeed the Eurofighter has a great development potential but it does need to be endowed with new capabilities and technological advances to bring it into line with the operating needs of the coming decades.

Nonetheless, the NGWS has to imply a technological leap from its development phase to be able to guarantee the availability of technological solutions meeting the established requisites within the necessary deadlines. These new technologies have to enable networking and operation as a command and control platform within a system of systems, (interacting with crewed and uncrewed components), while equipping the Eurofighter with sensors that ensure complete situational awareness and rapid and direct management of information (cutting human interaction to the bone) and facilitating decision-making whenever necessary. All this must also guarantee survival in disputed scenarios to ensure mission compliance.

Which NGWS area(s) do you think Spain should concentrate on within the key program components?

All NGWS areas are important in terms of meeting defined requirements. As well as the requirements impinging on the aerial platform and powerplant, one of the mainstays of the program will be connectivity and networking, thus guaranteeing the security of communications, interoperability with other systems and survival in the event of degradation.

Sensors will also be crucial in terms of establishing capabilities. They will mark the difference in future scenarios, not only due to their detection features but also their processing capacity and intelligent distribution of the suitable data.

The Spanish airforce is soon to receive the first RPAS Reaper from the United States. Spain also forms part of the European consortium that is going to develop the EuroDrone. How do both programs



fit into the ISR data obtaining strategy and what gaps will they fill?

The RPAS MALE MQ-9 PREDATOR B, once brought into service, will significantly boost the armed forces' JISR capability. The system will input persistent ISR capability, both daytime and nighttime, on land and sea, and with a limitless radius of action thanks to the use of satellite communications. The RPAS MALE also reinforces the State Air Action capability, for example in the fight against forest fires and in actions to deal with human rescues, catastrophes and emergency situations.

Nonetheless, the MQ-9 PREDATOR B system acquired by Spain is currently limited by the number of units procured and the missions that can be carried out. With the development of the European MALE RPAS system, therefore, the idea is to quantitatively increase the airforce's MALE fleet and qualitatively boost its capabilities (air-to-surface missile attacks, electronic warfare, maritime patrol, V mode and Link 16 connectivity, among others).

In the coming years the Spanish airforce is going to have to replace its basic and advanced training aircraft, CASA C-101 and Northrop

F-5M, respectively. How is this modernization process to be tackled in the training systems? And what is the planned timeframe for these replacements to meet airforce needs?

It is the airforce's intention to replace the current air platforms by an Integrated Training System (ITS) that takes in not only the aircraft themselves but also simulators, cabin trainers and computer training systems. This will streamline the pilot training process, speeding it up and reducing the number of air systems used, focusing the teaching on the arms systems to be flown in our aircraft and facilitating the transition towards them. The net result will be a reduction in the necessary aircraft fleet and a cut in maintenance costs and flying hours.

We are currently in the process of procuring the replacements for our long-serving C-101s, which have now clocked up nearly 40 years of operation. This replacement needs to have been phased in by 2021-2022, by which time, at the current pace of events, today's C-101s will no longer be capable of providing the necessary flying hours. Due to the tight deadlines, the replacement will have to be an already-developed off-the-shelf solution. In the case of



Manuel Pérez Cortés, general director of Defense and Security of GMV, during his visit to the Air Headquarters

the F-5s of the Attack and Fighting School (*Escuela de Caza y Ataque*) their replacement must be brought in by the end of the next decade, thereby giving the aeronautics industry time enough to develop an aircraft that meets all the future requirements of advanced teaching. The number of aircraft will thus be reduced from three to two, since there will no longer be a need to replace the T-35 Pillán aircraft, with the consequent saving in costs, personnel and also the time needed to adapt pupils to the new system.

There has lately been a lot of talk about developing in Spain a new training aircraft to cater for both basic and advanced training phases. The development of this aircraft will enable Spain's industry to keep up essential aeronautics capabilities. How does the Spanish airforce see the timeliness of this program?

As already explained in the answer to the previous question, one of the possibilities for replacing the F-5s is the development of a model adapted to suit our needs. The Spanish airforce supports the country's aerospace industry, considering it a keystone of a strategically important sector playing a

vital role in Spain's social and economic development. If it is eventually asked to carry out this program, the benefits will be obvious in terms of investment payback and maintenance of the aeronautics sector's capabilities. It should not be forgotten here that Spain is one of the few countries capable of carrying out the complete aircraft manufacturing process, from design right through to certification, including the development and production of the necessary systems and components.

And now looking even further ahead, where do you think Europe's aeronautics investments and efforts should be directed. Which technologies do you see as vital for the future of the armed forces?

Europe needs to work on inter-country collaboration to be able to meet the enormous investment of resources called for by an aerospace program, especially defense programs.

Looking elsewhere, the ongoing major technological advances now underway in today's society (Artificial Intelligence, Big Data, Augmented or Virtual Reality, 3D printing, 5G technology, etc.) have to be rapidly taken up by arms systems and duly adapted to suit their needs. This will call for a rethink of procurement processes to be able to speed up the incorporation into our

inventory of technologies that have already been widely taken up in civil society.

Looking at the future waiting for us, everything to do with Cybersecurity and connectivity between systems or components will be fundamental for the armed forces' future. Our operating scenario, after all, is shifting from a physical outlook to an increasing virtual and cognitive component; this has come to be dubbed multi-domain operations. In operations of this type armed forces like the Spanish airforce should be spearheading the transformation. This is so because its aerial resources are capable of rapidly reaching effects in all domains simultaneously, thus turning into the ideal tool for solving conflicts of the future.

Lastly, none of the space aspects should be overlooked either, as these will all be vital in the future. More and more of these new capabilities will be making use of space and these will be crucial throughout the whole armed-forces spectrum. The Spanish airforce systematically considers outer space to be an extension of the airspace where it carries out permanent surveillance and control. This sector calls for close civil-military collaboration to ensure that the airforce's experience and leadership is always used in the benefit of our society.



GMV takes part in the first demonstration of U-Space services under the DOMUS project

The ENAIRE-led DOMUS project is one of the five European projects selected by the SESAR program for demonstration of U-Space services for Unmanned Traffic Management (UTM)

During July the first demonstration of the DOMUS project was held. GMV is developing three of the main DOMUS services: tracking; emergency management and GNSS performance forecasting services for navigation and surveillance.

The central act of this demonstration, attended by several aeronautics and safety authorities plus SESAR, was held on 18 July in the Madrid head office of Spain's air navigation services provider ENAIRE, from where the various drone operations in the experimental flight centers of ATLAS (Jaén) and ÁNCORA (Lugo) were monitored.

This demonstration reproduced several scenarios involving uncrewed aircraft operations, such as a fire emergency situation or a drone/crewed-aviation integration operation, allowing an evaluation to be made of the various U-Space services carried out in this project.

The demonstration also involved a flight in a built-up environment, specifically in Villacarrillo (Jaén), under continual monitoring by U-Space services. This represented one of the first tests of this type carried out in Spain. In this scenario a test was carried out of integration of a Smart City platform with U-Space services, using for that purpose the emergency-management and tracking services of the **Drone locus**[®] suite.



GMV consolidates its aeronautics certification and development skills

■ In February and March certification of the critical operational software of the Electronic Control Unit (ECU) of the aileron/spoiler subsystem for the C-295 demonstrator aircraft passed two important milestones: the Planning Process Review (PPR) and the Software Requirements Review (SRR).

Development and validation of this software falls within the EMA4FLIGHT and VALEMA projects of the European Clean Sky 2 project. The purpose of these projects is development and validation of electromechanical actuators and ECUs for flight control systems to prove feasibility of the introduction of electromechanical actuators in aviation. Incorporation of actuators of this type forms part of an overall strategy of making More Electric Aircraft (MEA), significantly

cutting weight and emissions in comparison with current technology based on hydraulic systems.

Both milestones were approved by AIRBUS DS as the intermediary party responsible for certification by the State Air Safety Agency (*Agencia Estatal de Seguridad Aérea: AESA*) and they are both necessary steps for obtaining the Permit To Fly for this software, giving it clearance for embedding in the C-295 aircraft for flight testing. This clearance has been obtained in due accordance with the DO-178C guide for a level-A system, which is the most critical level under this standard.

GMV is responsible for development of ECU software, which, fundamentally, sees to communication with interfaces of various types (ARINC,

analogue, PWM, etc.), controlling the actuators in closed loop and exhaustively monitoring the state of the subsystem. GMV has also taken on other tasks such as selection of a suitable software-hosting Digital Signal Processor (DSP) that also allows for ECU hardware certification under DO-254.

All these milestones represent one more step within the critical operational software certification and development activities that GMV has now been carrying out for years for diverse Airbus programs. They also enhance GMV's certification and software development skills in other projects, such as the various developments for the flight refueling program, the flight control computer of the RPA ATLANTE and the ECU of the A400M aircraft's crane.



This project has received funding from the Clean Sky 2 Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement n° 755615

End of the drone standardization trials with Europe's GNSS systems



■ Late June saw completion of the third set of trials under the EGNSS4RPAS project for Europe-wide standardization of uncrewed aircraft (RPASs, UAVs and drones).

In collaboration with FADA-CATEC, GMV is one of the partners of this VVA-led project, which aims to standardize EGNOS and Galileo services in aircraft like drones, RPASs (Remotely Piloted Aircraft System) y UAVs (Unmanned Aerial Vehicle).

Under this project three test campaigns have been carried out (firstly, on 19 March; secondly, on 22 and 24 April; and, finally, on 25 and 26 June) with the common aim of weighing up the potential performance of Europe's navigation systems (Galileo and EGNOS) in the emerging and opportunity-packed field of drones, in relation to air traffic management or typical applications in built-up environments like package delivering, emergency healthcare products,

building inspections and critical infrastructure, etc.

The first two trial runs were conducted on the site of ATLAS, an experimental flight center belonging to the FADA-CATEC consortium and one of Europe's cutting-edge research centers. ATLAS has all necessary wherewithal for carrying out tests of this type, with an aerodrome exclusively for drones and a large segregated airspace, minimizing the chance of undesired encounters with other aircraft. The third test was carried out in the built-up environment of Villacarrillo (Jaén), after duly obtaining all necessary permits from the Spanish Air-Safety Agency (*Agencia Española de Seguridad Aérea*: AESA).

The European Commission is keen to demonstrate that its navigation systems could input an added value. In each test, therefore, the drones were fitted with **MagicUT**, the GMV-developed user terminal enabled for

SBAS (Satellite Based Augmentation System) and PPP (Precise Point Positioning) applications. This terminal can then assess performance in different scenarios and working environments. **MagicUT** has thus enabled the European systems' positioning performance to be compared with its American opposite number, GPS. As well as showing that, in most cases, it already outperforms GPS, another particularly noteworthy result was the more precise and robust performance achieved when these systems are used in combination rather than separately.

The European Parliament and Commission have recently approved the drone-operation regulation. This third round of trials in Villacarrillo represents an aviation milestone as the first in Europe ever to follow the methodology laid down in this new regulation, in particular a Specific Operation Risk Assessment (SORA) before awarding of the drone permit.



GMV completes the software certification process of A400M's ECU

■ GMV is developing both the software and hardware of the Electronic Control Unit (ECU) of the crane of the A400M transport aircraft. The ECU is responsible for control of the two BLDC engines of the crane (hoisting and shifting), and also brake control. The system-handling logic is implemented from user commands, taking into account the data supplied by load cells, diverse movement- and end-of-run sensors, temperatures, hoisting angle ...

The ECU has been developed under the strictest standards such as Airbus's ABD100 Directive and the software development standard ED-12B/DO-178B (level DAL-C). Development has been supervised by an independent certification authority, the European Aviation Safety Agency (EASA).

A landmark within this development came on 7 May with the Software Conformity Review, which represents the last necessary step by GMV for certifying the software of the Electronic Control Unit. This event involved the participation of Airbus,



the direct interface with EASA, plus CESA, project client. During this review a check was made of all evidence provided by GMV for control of the design, verification and configuration process, etc. Another check was likewise made of all software certification artifacts (coverage, metrics standard compliance ...) thereby

ensuring that software generation was in keeping with software development requirements under ED-12B/DO-178B, level DAL-C.

This was a red-letter event in GMV's history, as GMV's first ever completion of certification of this type under EASA rules.

GMV showcases its ISR capabilities as applied to unmanned aerial systems

GMV took part in the International Remotely Piloted Air System (RPAS) Week, run by the Intelligence 1 Regiment (*Regimiento de Inteligencia 1: RINT 1*) in Leon from 11 to 13 June. The remit of the seminar was to share information on systems, services, standards and technology associated with uncrewed vehicles and their capabilities.

The event featured military and civil speakers and participants from various countries, with representatives of diverse units of the Spanish army,

navy, the military emergency unit (UME in Spanish initials), Guardia Civil and National Police-force, plus representatives from the armed forces of foreign countries.

As well as various presentations of the current use of RPASs by armed forces under the NATO coalition and the likely future development, GMV was invited to give a paper on the development of Intelligence, Surveillance and Reconnaissance (ISR) capabilities and how they might add value to RPAS operations.

Javier Sanz (GMV's Head of ISR Programs Division) gave the paper "SAPIIEM: A suite of products to improve ISR collaboration and RPAS integration", which revolved around the SAPIIEM systems (**CSD Sierra, Atenea, Seismo, Collector, C2NEC**) developed by GMV under contracts with the Directorate General of Armaments and Materials (DGAM) of the Spanish MoD. These systems could play a key role in the sharing of information from the RPAS's onboard sensors, enhancing the efficiency of these resources and favoring joint ISR capability by armed forces and NATO.



CDTI awards GMV the contract for continuation of S3TOC operations

Since 2015 GMV has been leading the development of Spain's Space Surveillance and Tracking Operations Center, S3TOC. From S3TOC, in redundancy with France's space agency (CNES), Spain is providing space-collision surveillance and tracking services to a wide range of Europe's satellite operators, both institutional and commercial

Since 2015 GMV has been leading the development of Spain's Space Surveillance and Tracking (SST) Operations Center, S3TOC, based in Torrejón de Ardoz airbase. S3TOC came into operation in July 2016 under GMV's administration and coordination.

Since then Spain, represented by the Industrial Technology Development Center (Centro para el Desarrollo Tecnológico Industrial: CDTI) of the Ministry of Science, Innovation and Universities, has been providing from S3TOC the SST services as part of the European Commission's dedicated SST program (EUSST), doing so in a consortium with France, Germany, Italy and the UK, augmented in 2019 to take in Poland, Romania and Portugal. These services are provided to users from the

EU Satellite Centre (SatCen), also sited in Torrejón airbase.

S3TOC pools data from telescopes, radar and laser sensors in Spain and other consortium countries plus data from external sources like USA's precise catalogue, to keep up a catalogue of objects orbiting the Earth. Drawing from this catalogue, collision-alert services are provided to enable satellite operators to forecast potential collisions and carry out any necessary avoidance maneuvers.

Since mid-2018 Spain has been providing these collision-avoidance services from the S3TOC along with France (CNES) on a hot redundancy basis to a large number of European satellite operators, both institutional and commercial. Spain is thus spearheading the worldwide provision of these fundamental services to ensure

the safety of today's space missions and the future sustainability of all space operations.

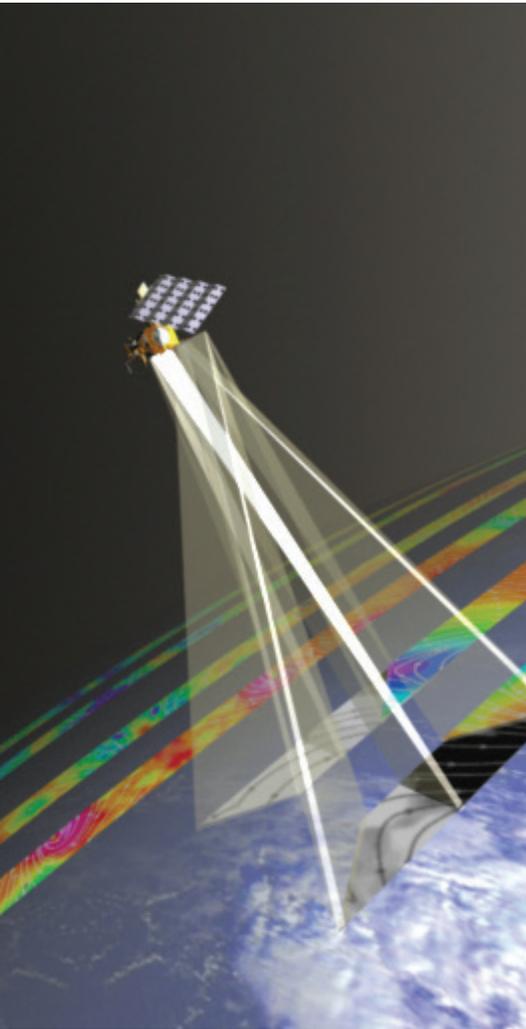
In September 2019 GMV has been once more awarded with the S3TOC operations contract with CDTI. This contract, in which GMV counts on Deimos, Indra and Hisdesat as subcontractors, will initially run for 26 months with a potential one-year extension.

At the moment over 40 GMV engineers are working on space-debris tracking and surveillance programs in 6 different countries, making the company one of Europe's and worldwide top stakeholders in this field. GMV has been providing its own SST services and developing its own inhouse technology for over a decade now. This expertise was a crucial factor for the development and operations of the S3TOC.



GMV leads the development of Polish SST Operations Centre

■ GMV in Poland together with its partner Sybilla Technologies, has delivered operational software for the development of the Polish Space



Surveillance and Tracking (SST) Operations Centre (SSAC-PL) for the Polish Space Agency. It will be used for collecting, verifying and processing Polish sensor network's data about space objects. The system will also facilitate the exchange of information with the EU SST consortium database. GMV acting as a prime contractor is responsible for development, deployment and maintenance of the system.

EU SST (Space Surveillance and Tracking) is the European Commission initiative aimed at increasing capabilities of Member States to safeguard the European and national space infrastructure. Poland has joined the consortium at the end of 2018 but only now, thanks to the system delivered by the GMV-led consortium, is able to participate entirely in this program.

The part of the software delivered to Polish Space Agency by GMV is based on the **Sstod** COTS proprietary solution designed to carry out orbit determination and propagation computations based on measurements obtained by SST sensors for resident space objects. The software provides two separate functions: orbit determination, based on SST measurements (including bias estimation for SST sensors calibration purposes); and orbit propagation, based on a previously computed orbital state.

Sstod software has already been proved under stringent operational conditions and tested in a wide variety of scenarios including regular Flight Dynamics, data fusion for SST and precise orbit determination. It is used by a wide range of customers including 30+ satellite operators with hundreds of satellites in all orbital regimes (LEO, MEO, HEO/GTO, GEO) and space agencies such as NASA, ESA, EUMETSAT and DLR.

GMV's Poland subsidiary has been involved in SST related projects for nearly five years. As an example, in cooperation with ITTI and Adam Mickiewicz University in Poznan, GMV has defined SST component architecture for the future Polish SSA system and provided expert support for the consortium. Additionally, in another project led by 6ROADS, GMV was responsible for qualification of the Polish network of telescopes according to EU SST consortium and ESA standards. Finally, GMV Poland's subsidiary has actively contributed to development of ESA's SST processing infrastructure by participating in 3 projects in close collaboration with Spain's subsidiary. These crucial projects were aimed at the development of the ESA's Fragmentation Analysis System (FAS) and at the integration and maintenance of the overall ESA's SST Data Centre.

New Harwell Space Cluster Showcase

GMV took part in the latest Harwell Space Cluster Showcase, the meeting that, involving the main space organizations like ESA, turbocharges the UK's space sector.

The venue this year, on 27 June, was Harwell Campus (Oxford), where 30 of the 92 organizations now making up this cluster came together to find out about the latest developments in the UK space

sector as well as the accomplishments of the campus's own space organizations.

The overarching aim this year was to showcase the latest technologies and applications driving the future growth of spinoff products and services from space activities.

GMV, running a company in Oxfordshire (UK), is right behind the

development of UK's space sector. In this Showcase the company was able to present its current range of products and services for the space segment (guidance, navigation and control), ground segment (telecommunication-satellite control centers, earth-observation data processing systems and applications using space technologies and data) and robotics.



Artificial Intelligence will facilitate autonomous management of space collisions

■ The threat posed by space debris to operational satellites is becoming a serious problem. Currently there are nearly 20000 catalogued objects larger than 10cm in LEO and 1m in GEO and more than one hundred times as many smaller fragments down to 1cm.

America's 18th Space Control Squadron (18 SPCS, formerly JSpOC) issues collision alerts (called CDM) whenever an upcoming conjunction is detected between an operational satellite and the catalogued population of objects in orbit. These messages are the main source of information for satellite operators to decide on the need to perform dedicated collision avoidance maneuvers in order to reduce the collision risk below an acceptable level.

These critical operations are generally difficult to automate and usually lead to stressful situations implying critical and urgent decision-making procedures, taking into account a large number

of factors and different sources of information.

When dealing with small satellite fleets or orbiting in regions in space not densely populated, the number of alerts can be manageable by means of well-established procedures and intensive manual operations. In the case of large fleets, however, and particularly when operating in crowded orbital regions, the number of alerts would soar to almost unmanageable levels.

This implies the need to automate such operations in order to increase safety while limiting operational costs. However, the decision-making in the collision avoidance problem (whether maneuver or not) is not simple to automate as many factors need to be taken into consideration.

Nonetheless, there is a significant amount of past experience to draw on while performing these operations,

and well-trained satellite operators could make their decisions accordingly (with sufficient time for analysis). This information, drawn from decisions made in real or simulated scenarios, could hence be used as generic algorithm-training data. Here is where the concepts of artificial intelligence and, particularly, machine learning come into play.

GMV has started in Romania the development of an Autonomous Collision Avoidance System along with Eutelsat, within an ESA project under the ARTES program. This inhouse system will be based on the use of machine learning techniques and is intended for future use by large fleets (e.g. large operators in GEO and future mega-constellations in LEO and MEO) and also in orbit raising scenarios with full-electric satellites (e.g. orbit transfer from LEO to Upper-LEO for deployment of a large constellation or from LEO/GTO to GEO for a large telecom satellite).



GMV participates in the inauguration of the ExoMars Rover Control Center

■ Since 2007, under a contract with the European Space Agency (ESA), GMV has been responsible for supply of the Rover Operations Control System (ROCS) of Rosalind Franklin, the rover for the ExoMars 2020 mission.

ExoMars, a joint mission of the European Space Agency and the Russian Space Agency Roscosmos, is a two-part venture that aims to investigate the Mars environment and try out new technology for looking for traces of life and collecting Mars soil samples in the 2020s.

The Rosalind Franklin Rover Operations Control Centre (ROCC), to be used on this mission, is located in Turin, Italy. The Rover Operations Control System (ROCS) is responsible for most of the functions of the ground segment, providing the core capabilities for all the following: telemetry signal reception

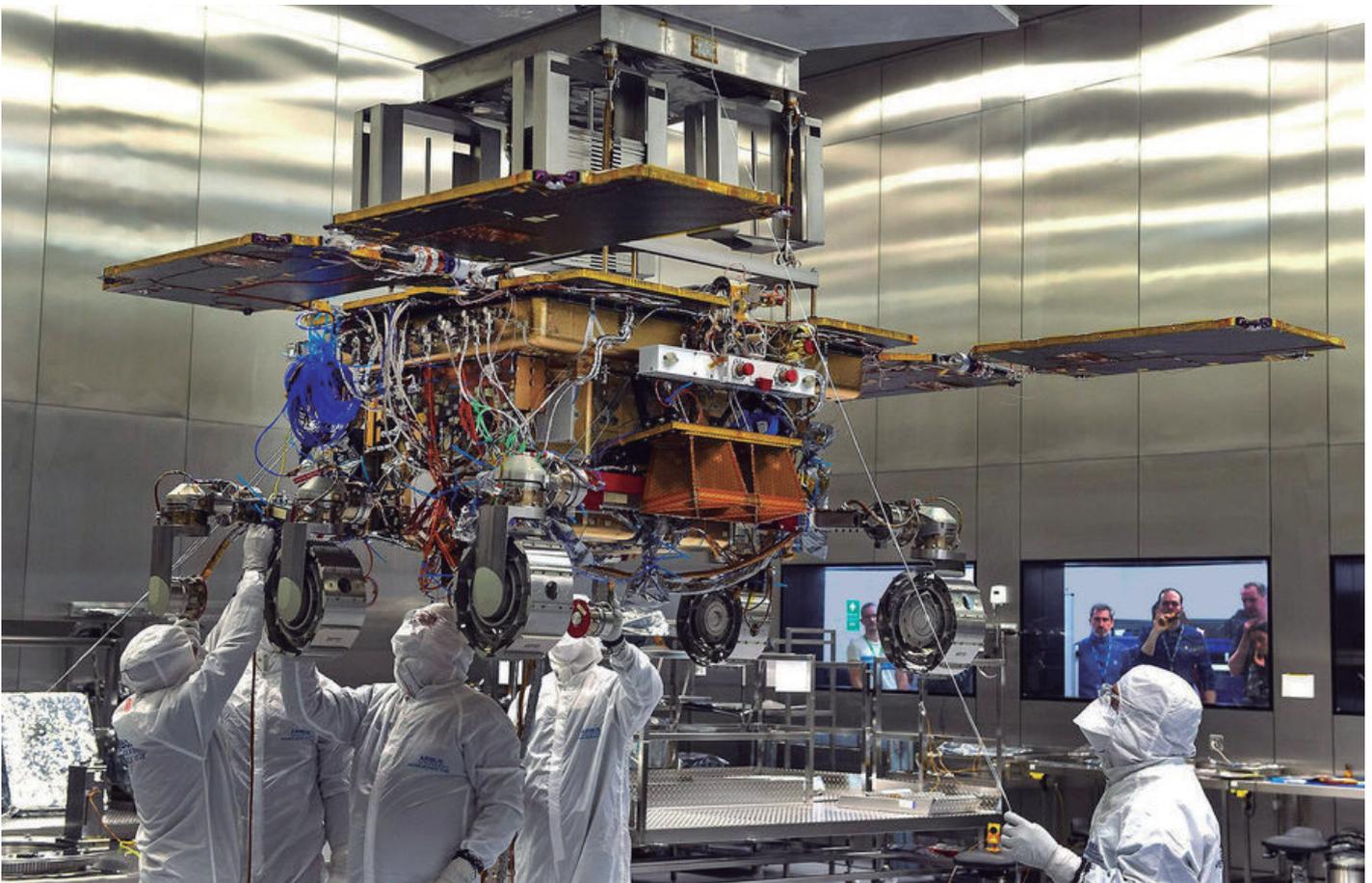
and analysis functions; engineering and science assessment and vehicle planning; simulation of the activities plan and generation and validation of the telecommand sequence; management of onboard software and uplink communication of telecommand sequences.

The ROCS has been designed to establish the rover operations concept and also to provide support for all ground control processing activity, as need be. Operators will therefore need advanced planning capabilities, taking into account the mission, the environment and any constraints in the resources that help to generate and pass on to the rover a plan free of limitations and errors.

On 30 May GMV was invited to the official inauguration of the Rosalind Franklin Rover Operations Control

Centre (ROCC) held in ALTEC's Turin site in Italy. The center will come on stream eight months after the ExoMars spacecraft has blasted off from Baikonur, following completion of its long interplanetary journey and the critical descent on Oxia Planum. As such the official opening of this center represents yet another stride forward in the European space industry's first trip to the red planet.

In this second mission GMV is also participating in development of the complete application software of the guidance, navigation and control (GNC) system and other subsystems (thermal system, remote-command system, guidance and control of the carrier module as well as the descent module, power system). It will also be developing the software Verification Facility (SVF) used for validating the application software.





HellasSat 4 in operation with the GMV control center

■ At the end of July operation of the satellite HS-4/SGS-1 was transferred to Hellas Sat, a subsidiary of Arabsat.

Launched on 5 February, SaudiGeoSat 1/HellasSat 4 (shortened to HS-4/SGS-1) is a Lockheed Martin geostationary telecommunications satellite shared between KACST and Hellas, designed to provide television, internet, telephony and secure communications for the Middle East, South Africa and Europe.

GMV has developed the Hellas Sat 4 flight-dynamics system and the control and monitoring center. Both systems have been developed from GMV's inhouse **FocusGEO** and **Hifly**® families. Both solutions have been successfully integrated and deployed in a modern and ecofriendly virtual environment using blade and vSphere services. Together with these solutions GMV has also provided **Central log**, a tool pooling all the

system alarms and events; GMV will also be providing training, support and maintenance for the system's final users.

The launch of this satellite and its operational commissioning will represent further success in both GMV-developed satellite control systems, also deployed and integrated in their forerunner Hellas Sat 3.



GMV attends the latest SATELLITE

■ From 6 to 9 May the Walter Edward Washington Convention Center in Washington D.C. hosted the world's most important satellite-technology event, SATELLITE 2019, bringing together representatives from the top telecommunications-satellite companies.

GMV now boasts a wealth of experience in ground-segment development and is currently the world's number-one supplier of control systems for telecommunications space missions. As such it could hardly miss this event in a world where telecommunications is becoming increasingly interrelated and connected and underpins other important markets like the media,

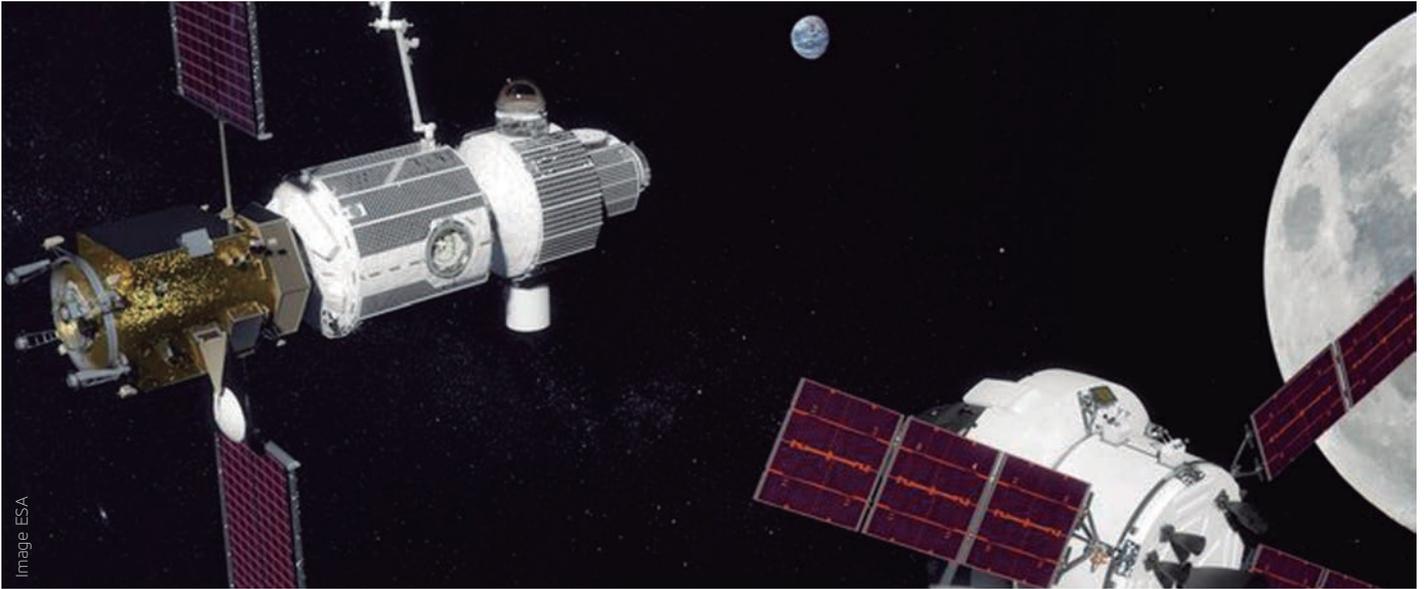
transport, finances and even the consumer industry.

GMV, with the support of the Spanish External Trade Institute (*Instituto Español de Comercio Exterior*), exhibited its products and services, showcasing especially its ground-segment control systems such as **Hifly**® (satellite control), **Focussuite** (orbit control), **Closeap/Focusoc** (collision risk management and associated services), **Flexplan** (satellite-resource planning system), magnet (monitoring-station control), **Smartrings** (configuration management and payload optimization) and **Smarthz** (frequency-management system); plus network-security and vulnerability-analysis services.

This event is the world's best showcase for in situ display of products, offering the possibility of holding real-time demos for both actual and potential customers while also pinpointing new needs in the space industry.

Its comprehensive lecture program represents a unique yearly chance to do some networking and swap notes on sector breakthroughs. One of the most important networking activities was the event organized by Spanish companies in the Spanish Embassy of Washington, presided over by Ambassador Santiago Cabanas Ansorena.

GMV working for future Lunar exploration



■ 20 July this year marks the 50th anniversary of the historic moment when humankind first trod the moon, widely regarded as one of the most epoch-making feats of all time.

In those days the moon was the main target in the space race between the USSR and USA. In the mid-seventies, however, lunar exploration stalled. From 1958 to 1976 a total of 100 missions were launched to our satellite; in the following 14 years up to 1990, none at all.

From 1990 to 2007 there were only four minor missions to the moon, all involving low-cost light orbiters: a Japanese mission, Hiten; two small American probes, Clementine and Lunar Prospector; and the European technology demonstration probe SMART-1. In the latter GMV played a key role during the design phase and optimization of possible trajectories to the moon, using low-thrust propulsion, a technology then in its infancy. It was also involved in the development and operation of the necessary tools for control of the actual trajectory and orbit insertion of the probe before it was deliberately crashed into the moon's surface.

In 2007 NASA and other space agencies took a renewed interest in the moon.

Since that watershed year there have been four important moon launches: The Japanese Kaguya mission, the Chinese Chang'e 1, the Indian Chandrayaan-1 and America's Lunar Reconnaissance Orbiter (LRO) mission.

LRO, launched in 2009, marked NASA's successful return to the moon after a ten-year absence. Its aim was to pave the way for future settlement of the moon, analyzing, among other aspects, the ideal site for a permanent lunar base. GMV's inhouse product **Flexplan** served as the basis, crucially, for the mission's planning and programming system.

In recent days the story of lunar exploration has picked up anew and GMV is helping to write its most immediate future. The company is currently actively involved in the development of an autonomous lunar soft touchdown system (PILOT) under ESA/Russian collaboration in the Luna 27 mission. It is also participating in the design of a multi-spectral camera prototype for cislunar-orbit rendezvous and is leading definition of the guidance, navigation and control (GNC) system of HERACLES, a robotic mission to scout the terrain ahead of man's real return to the moon. This mission is being led by the European Space Agency (ESA) with the collaboration of the Canadian

Space Agency (CSA) and the Japanese Aerospace Exploration Agency (JAXA).

The international HERACLES mission's rover will collect lunar samples for two months, monitored and controlled by the future lunar Gateway, which will then pick up these samples and send them back to earth. After the samples have been sent off, the rover will continue to scout the moon for a whole year in preparation for future crewed missions.

In the HERACLES mission GMV is heading the consortium in charge of designing the guidance, navigation and control (GNC) system for ascent from the moon's surface, orbit transfer and rendezvous and docking with the lunar Gateway. At the same time GMV is also responsible for the GNC of the rendezvous and docking phase in one of the two system studies, primed by Thales Italia, being carried out by ESA in parallel to design HERACLES's rest component.

The mission poses various concurrent technological challenges to do with propulsion, GNC, communications or combined control from earth and from the lunar Gateway. This all adds up to a sterling challenge for Europe's space exploration itself and will lay down the bases for the future colonization of the earth's natural satellite and missions to more distant planets.



GMV consolidates its position as Europe's main supplier of Galileo service centers

The new version of the European GNSS Service Centre (GSC), which forms part of the infrastructure of Europe's navigation program Galileo, successfully passes the Qualification Review (QR), a crucial milestone greenlighting the start of operational validation

On 20 June the Qualification Review (QR) was held of the new version of the European GNSS Service Centre (GSC). The GSC forms part of the infrastructure of Europe's Galileo navigation program. Its main role is to provide support and consultancy services for user communities of the system's open and commercial services. The center is conceived as a think tank for exchanging knowledge, performance analysis, bringing GNSS to wider notice and providing support for the provision of value-added services by the system's open and commercial services.

The GSC is run by the European GNSS Agency (GSA) with the support of Spain, which provides the Galileo program

with the necessary infrastructure and facilities for hosting the center.

The GSC is housed in a totally secure environment in Madrid, Spain, on the site of the National Aerospace Technology Institute (*Instituto Nacional de Tecnologías Aeroespaciales: INTA*) in Torrejón de Ardoz, supervised by the Spanish MoD. The agreement to site the GSC in Spain was signed in May 2011 by the European Commission and the government of Spain, and then published in the Official Journal of the European Union in February 2012.

In 2014 a GMV-led consortium won the framework contract for supply of GSC infrastructure, holding onto this responsibility ever since.

This new version represents a crucial development. As well as the previous

functions of user and commercial services it includes the Galileo Authentication service. This service will allow users to be sure the signal they are receiving comes from Galileo, guaranteeing security and dependability in signal use.

The event was declared to be a success. This has kick-started operational validation ahead of its coming into operation, scheduled for the end of the year. As well as this crucial development, the first version of the center's consortium-developed website has also recently been brought on line, allowing users to sign on, make queries and access the various services.

This portal provides all information on Europe's Galileo navigation system. Once registered, it will also give access to all Galileo products and services.

The development of this center consolidates GMV as Europe's main supplier of Galileo service centers while reaffirming its position as a dependable partner of the GSA and the European Commission.



Successful launch of EDRS-C satellite

■ On 6 August, at 21.30 hours CEST (19.30 hours UTC), EDRS-C, the second satellite of the European Data Relay System (EDRS) constellation, was successfully launched atop an Ariane 5 rocket from the European Spaceport of Kourou (French Guiana).

EDRS-C is an Airbus-owned spacecraft, equipped with a Laser Communication Terminal and Ka-band RF equipment, acting as the second GEO node of the EDRS (European Data Relay Service) infrastructure on which the Airbus SpaceDataHigway commercial-service is based.

The SpaceDataHighway is the world's first 'optical fiber' network in space, based on laser technology which can transmit data at a rate of 1.8 Gbit/s.

SpaceDataHighway geostationary satellites can connect via laser link to Low Earth Orbit observation satellites at a distance up to 45,000 km and then relay observation data to Earth in near-real-time, a process that would normally take around 90 minutes.

As of today four ESA Sentinel satellites are connected to the SpaceDataHighway for sending to ground high-quality images.

In 2020 Columbus (the ISS European module) will start using the service for establishing a direct datalink to Europe, bypassing the NASA Ground Segment. Airbus is currently testing an airborne laser terminal which will also enable intelligence UAVs and aircrafts to connect via laser link to the EDRS GEO nodes.

GMV is supporting the EDRS infrastructure with major contributions and responsibilities in the development of the EDRS-A and EDRS-C Payload control center, in the EDRS-C Spacecraft and Ground Segment Product Assurance and in the EDRS-C Spacecraft Operations.



GMV takes up a pole position in the development of Europe's future launch vehicles

The European Space Agency is preparing new launch systems to meet Europe's future institutional needs and to continue spearheading groundbreaking space developments. In 2003 it set up the Future Launchers Preparatory Programme (FLPP), a program designed to safeguard Europe's guaranteed access to space, weighing up the opportunities and risks of various launch-vehicle concepts and associated technologies.

The programme's demonstrators and studies fine tune emerging technologies to give European launch-vehicle firms

a competitive edge when converting the chosen design into an actual vehicle.

On 4 July last, as part of this overall endeavor, Emanuele Di Sotto, Head of GMV's SPS (Space Segment and Robotics) Launchers and Entry Systems Division, took part in the Paris Workshop on Future Launchers Preparatory Programme (FLPP).

This workshop, organized by ESA's Space Transport Strategy (STS), brought together sector experts to talk about the priorities and activities of future space transportation solutions. These activities will then be proposed in Space19 +

for the future preparation of space transportation.

During the event GMV showcased in situ the engineering models of some of the MIURA-1 launcher's avionics components, which have been designed and integrated by GMV and its partners PLD Space, Seven Solutions and Anteral. Specifically, the onboard computer (OBC) and the inbuilt S/L band antenna were presented together with several engineering models of the main FLPP-funded projects. These included Prometheus, the new LOX- methane engine, which will be the main element of the future ArianeNext launcher.



GMV successfully contributes to the European Commission's DIAS platforms

GMV has led a consortium that has set up the centralized data catalogue, the catalogue of virtual machines for users, the virtualized processing environments and the Big Data processing clusters of WEkEO, the fifth European DIAS platform (Data Information Access Services) to facilitate online access to Copernicus data

On 6 June, as part of the ongoing development of the WeKEO platform, the latest and decisive event of the “WEkEO Processing Tools and Software” project took place, in which GMV has led the consortium under the aegis of the European Centre for Medium-Range Weather Forecasts (ECMWF).

WeKEO, the fifth European DIAS platform (Data Information Access Services), a joint initiative of ECMWF, EUMETSAT and MERCATOR OCEAN, facilitates online access to Copernicus data.

DIAS platforms allow users to access, search for, download and process Copernicus data openly and free of charge. This data may come from Sentinel satellites or any of Copernicus's six specific services (atmosphere monitoring, marine environment monitoring, land monitoring, climate change service, security and emergency monitoring service).

Based on an open-architecture concept, WekEO will offer cloud-based processing tools and services. Virtual machines will provide preconfigured data-processing environments for implementing value-added services and applications that do not call for a transfer of large amounts of data to the network.

GMV has led the six-company consortium that in only six months

has set up all the following: the centralized data catalogue of the WEkEO platform; the catalogue of virtual machines for users, ready to operate on a hybrid cloud of IaaS platforms; the virtualized processing environments and the Big Data processing clusters using Apache Spark and TensorFlow technology, including proofs of concepts in the various scientific domains.

To ensure operability of all these products in WEkEO's hardware infrastructure, the consortium has built from scratch a hybrid cloud model and

a complete continuous integration and development environment.

With this project GMV features as the first Spanish firm to take part in the DIAS program since its kickoff back in 2016 and it does so by taking on complete responsibility for the first great WEkEO contract, a critical activity for development of the rest of the platform.

GMV's integrator skills and experience in the technology domains involved in this project were key factors in its successful completion of this project within such a tight deadline.



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President of the Portuguese Space Agency visits GMV in Portugal

■ GMV in Portugal had the honor of hosting the visit of Chiara Manfletti, President of Portuguese Space Agency – PT SPACE – in the past month of May. Following the official presentation of the agency during the “Portugal Space, ESA and the European Space Program (2021-2027)”, Chiara Manfletti started the conversations with Space stakeholders and key industry players, GMV to the fore.

Building on the national strategy ‘Portugal Space 2030’, PT SPACE aims at making Portugal a place of space-related innovation, based on scientific excellence and competitive industrial capabilities, generating high level jobs, inspiring young generations and positioning Portugal as a significant contributor of progress in the world.

Alberto de Pedro Crespo, General Manager, and Teresa Ferreira, Director of Space,

guided Chiara Manfletti during the visit to GMV’s Lisbon offices, presenting the Portuguese team as well as the main projects the company is running in the space sector.

GMV considers it crucial to reinforce investment in the space sector in order to increase technological maturity of the national space industry and further promote the industry’s progress in the value chain.

GMV takes part in the new edition of EUCASS

■ GMV took part in the eighth European Conference for Aeronautics and Space Sciences (EUCASS 2019), a benchmark sector conference held this year from 1 to 4 July in the Polytechnic University of Madrid (*Universidad Politécnica de Madrid*).

The program, with 110 technical sessions, dealt with burning issues such as system integration, flight physics, propulsion physics, structures and materials, reusable launch systems, avionics, GNC (Guidance, Navigation and Control), flight dynamics and space debris, among others.

As well as running a stand in the exhibition area, to showcase its various space activities, GMV took an active part in several congress sessions.

Emanuele Di Sotto, Head of GMV’s SPS Launchers and Entry Systems Division, chaired the session “GNC Return of Experience, Verification & Validation”.

In the space navigation session GMV presented a paper on development and qualification of the avionics of the MIURA-1 launcher, PLD Space’s suborbital rocket designed to dry-run the technology of the future MIURA-5. GMV is working jointly with the Spanish

startup in the development of the complete avionics.

Another key participant was Andrea Pellacani, GMV Project Manager, who, during two technical sessions, presented HERA, the mission designed to study the Didymos binary asteroid. GMV is leading the international HERA consortium in charge of mission analysis and GNC. In the Space Surveillance and Tracking (SST) area, GMV gave a paper under the title “Challenges, strategies and methodologies to build-up and maintain space objects catalogues”, sharing its knowledge and expertise in the cataloguing of space debris.

GMV forms part of the Portuguese delegation visiting Airbus Defence and Space in Toulouse

On 21 May, Teresa Ferreira, Director of Space for GMV in Portugal, was a member of the Portuguese delegation in the visit to Airbus Defence and Space (ADS) in Toulouse, with the additional participation of Portuguese industries, research centers, academics and clusters.

The event, which aimed at promoting future collaborations in the aerospace areas, was led by Manuel Heitor, Minister of Science, Technology and Higher Education of Portugal. According to Manuel Heitor, it is crucial to promote



the development of the Portuguese space sector, especially in terms of earth observation downstream and small satellite construction.

The Portuguese delegation also included Chiara Manfletti, the Portuguese Space Agency President.



AfriCultuReS rewarded by the GEO and Amazon Earth Observation Cloud Credits Program

■ AfriCultuRes (Enhancing Food Security in African Agricultural Systems with the support of Remote Sensing), presented by the South African National Space Agency, is one of the projects that has been selected for the Earth Observation Cloud Credits Programme. Under the Amazon Sustainability Data Initiative (ASDI), this credit program will favor sustainable development of a wide range of earth observation applications.

The AfriCultuReS project, carried out by a GMV-led consortium, sets out to design, implement and operationally validate an integrated monitoring, analysis and early-warning system to contribute towards the improvement of food security in Africa. AfriCultuReS, a four-year, European Union Horizon-2020-funded project (contract 774652) worth 8.5-million euros, kicked off in late 2017. The consortium is made up by eight African and nine European

organizations, each of them a leader in its respective field like climatology, meteorology, crop modeling and monitoring, information technology, social sciences and earth observation.

AfriCultuReS meets small farmers' need for trustworthy information, hard to come by otherwise. This will allow them to improve farming decision-making procedures to safeguard output by means of risk management, helping them to become more adaptable and resilient to climate change.

AfriCultuReS recognizes from the outset that reaching small farmers one by one calls for an effort that is beyond project resources. Without losing sight of the end beneficiary, therefore, the project tackles service provision by means of "agri-aggregators" like national or regional governments, agricultural extension services, farming cooperatives, input

suppliers or banks, to name only some.

The project will draw on data from the Sentinel satellites of the European Copernicus program, together with field data, climate models, meteorological models and crop forecasting models. This award therefore represents a huge boost to the project, since access to large datasets and cloud services will slash costs and time and overcome many of the technical hurdles balking service provision.

But this essential cloud capacity is not the only boon; to this must be added the subsidy and technological support included in this award. There is therefore no doubt that AfriCultuReS has taken a huge stride forward in its goal of providing the necessary information for sustainable agriculture, management of natural resources, conservation of biodiversity and reduction of poverty in Africa.

The Azores host the New Space Atlantic Summit

■ Following recent developments in the space sector, and more particularly in Portugal, the 2019 New Space Atlantic Summit took place on the island of Santa Maria, Azores, on June 21-22. This event addressed the take-up of opportunities offered for the space and non-space sectors in general and more precisely in Europe and the larger Atlantic area.

Participants of this year's Summit had the opportunity of sharing their unique view and contribution to each theme and actively promote their advancement. Miguel Ángel Molina, Business Development Manager Aerospace, and Teresa Ferreira, Space Director at GMV in Portugal, talked about GMV's strategy and positioning in the space sector, namely the importance of the company's collaboration and participation in the Space port



project. Teresa participated in the panel dedicated to Sustainable Development and Technological Breakthroughs.

The Summit was marked by a tour of the main space sites of the island of Santa Maria.

GMV presents the BIBLOS project at the Polish Academy of Sciences



■ The Committee on Space Research at the Polish Academy of Sciences has recently organized a Space Observations seminar. Two GMV representatives, Robert Kędzierawski and Wojciech Oryszczak, presented BIBLOS project, which stands for Building BLOcks for Earth Observations mission performance Simulators. In a nutshell it is a library of software units called “Building Blocks”, or simply

“Blocks”, that can be used to build an end-to-end simulator (E2ES).

End-to-end mission performance simulators (E2ES) for Earth Observation missions are one of the prominent tools for system design and scientific validation in early mission phases. An E2ES is used by the scientists and the engineering teams to simulate the acquisition and

generation of satellite products. The BIBLOS project, led by GMV, is designed to speed up development of E2ES while reducing its costs and avoiding re-engineering at the same time.

In addition to the theoretical part, the speakers also presented practical models for the use of designed libraries to assemble the simulation chain.

GMV supports the latest international GNSS Summer School

■ The 12th ESA/JRC International Summer School on GNSS was held in Vila Nova de Cerveira, in the north of Portugal, from 15-26 July 2019.

The event was promoted by the European Space Agency (ESA) and the Joint Research Centre (JRC), with the collaboration of Oporto University and several external sponsors including GMV.

The Summer School represents a unique chance for young satellite navigation researchers to get all the latest high-level information from renowned worldwide scientists and specialists.

The objective of this Summer School is to give an overview of satellite navigation, exploring the theoretical bases of the Global Navigation Satellite System (GNSS), its signals, the processing carried out by signal receivers and, finally, determining the position-navigation-time (PNT) solution. The program featured hands-on workshops, giving a realistic idea of the work carried out in this area.

Throughout the week attendees also had the chance of talking about the future of satellite navigation systems and set up a group business project

based on a groundbreaking idea, taking into account the product or service business plan, its technical performance and, finally, its marketing to end clients.

As one of the main sponsors of the event, GMV had the opportunity of speaking to the attendees and presenting the company as well as some of the main GNSS projects. Pedro Fernandes, Section Head GNSS Signal Technologies of GMV in Portugal considered this a great moment for sharing ideas and inspiring these young people.



EUTELSAT's latest satellite successfully launched

■ On 20 June the new satellite of the EUTELSAT fleet was successfully launched atop a Ariane 5 rocket from the European Spaceport of Kourou in French Guiana.

Eutelsat 7C is a telecommunications satellite with totally electric propulsion built by Maxar Technologies. The satellite carries onboard forty nine 36-Mhz high-power

equivalent Ku-band transponders with the main purpose of providing video services for Africa, Europe, the Middle East and Turkey.

Eutelsat 7C will be co-located with Eutelsat-7B, launched back in 2013, and will take over from Eutelsat 7A, which will be transferred to another orbital location as part of Eutelsat's ongoing fleet optimization strategy.

EUTELSAT, one of GMV's marquee clients, is now running GMV-developed control systems for its complete satellite fleet, prime among them being the multi-satellite control system **Hifly**® and the flight-dynamics system **Focussuite**.

This mission represents the fifth launch by Arianespace's family of launch vehicles in 2019 and the second with Ariane 5.



GMV takes an active part in the Portugal Air Summit

In 2019 Portugal Air Summit once again brought together the industry's leading organizations and personalities to debate and analyze Aviation and Aeronautics potential and future growth.

After the huge success of the two prior Portugal Air Summits, the third Summit was held at Ponte de Sor Municipal Airfield, between 30 May and 2 June, with the banner theme "Powering Human Capital".

This year, the 2019 International Workshop for Global Sustainability

was included in the Summit, and Teresa Ferreira, Director of Space for GMV in Portugal, talked to the audience on the first day about sustainability and the future of Aerospace.

The workshop was promoted by NASA and ESA within The Partnership for Global Sustainability - a global network of public and private organizations and individuals that works at the nexus between the space and aerospace sectors and terrestrial sustainability challenges.



GMV hosts the system requirements review meeting of the European Robotics Project PRO-ACT

The meeting set out to take stock of the reuse of previously developed common building blocks and their applicability in the establishment of PRO-ACT, one of the projects selected by the European Commission for funding in the second phase of the space robotics Strategic Research Cluster (SRC), the European Commission's biggest robotics program



On 23 and 24 May GMV's Madrid head office in Tres Cantos hosted the System Requirements Review meeting of the European PRO-ACT project (Planetary RObots Deployed for Assembly and Construction Tasks).

PRO-ACT is one of the 5 projects selected for European-Commission funding in the second phase of the space robotics Strategic Research Cluster (SRC), the European Commission's biggest robotics program.

The program's second phase sets out to integrate, reuse, adapt or extend the common technology building blocks previously developed in on-ground demonstrators in the first phase. This will help to drive the development of future space robotics applications for orbital and planetary use (phase O/A studies) to meet not only the

future needs of space exploration and exploitation but also potential spin-off and spill-over effects to other areas of robotics activity on Earth.

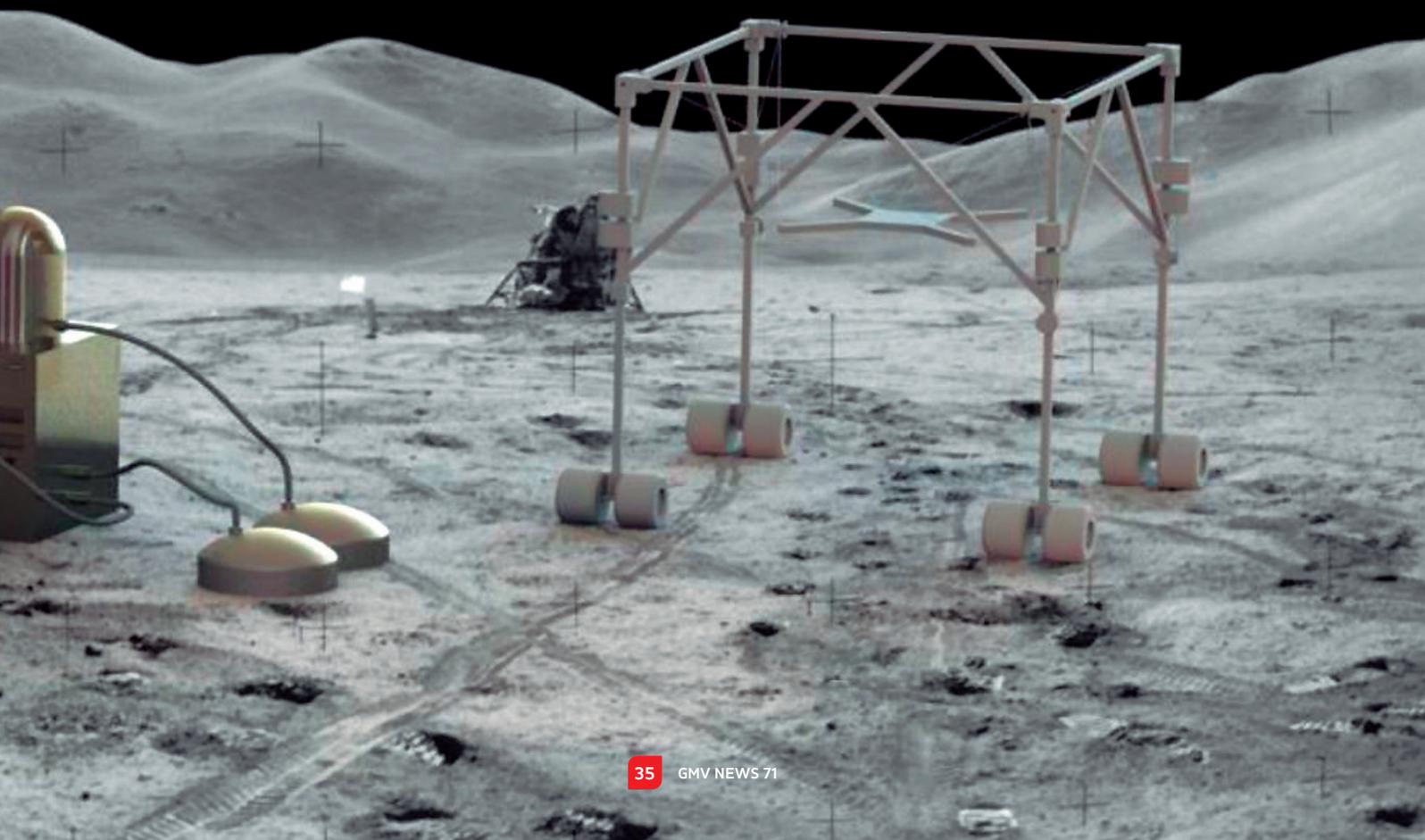
The PRO-ACT project, run by a 9-partner consortium primed by Space Applications Services, addresses the problem of a precursor lunar base by assembling an in-situ resource utilization (ISRU) system, doing so with the aid of cooperatively acting mobile robots. These capabilities will be essential for the establishment of future human settlements.

PRO-ACT will be using all the common building blocks (OG1-5) developed during the first phase of the program, pride of place going to European Robotic Goal-oriented Autonomous Controller (ERGO) and the European Space Robot Control Operating System (ESROCOS); the two GMV-led building blocks in the cluster's first phase.

GMV is also participating in multi-robot architecture definition (planning /monitoring/execution); in the development of support systems (communications, control center and ground monitoring); in the integration of common building blocks developed in the first phase plus testing activities and bringing result to wider notice.

The meeting, including consortium partners and representatives of the European Commission (EC) and Programme Support Activity (PSA), set out to take stock of the reuse of previously developed common building blocks and their applicability in the establishment of PRO-ACT.

Both review teams (PSA and EC) congratulated the whole consortium on the work carried out to date and ongoing adherence to project goals.



GMV carries out the first tests of the prototype BEAST rover



■ On August 8, on the Harwell campus (Oxfordshire, UK), GMV carried out the initial Shakedown test of the new mobile robot system nicknamed

"BEAST". This is a test whose objective was to validate the functionality of the platform before upcoming tests in autonomy. The

results from the test will be used for different projects within the framework of the Innovate UK R&D program.

BEAST is a new GMV rover system that is still a prototype with many subsystems to be added and improved for the final trial scheduled for March 2020. On this first time out of the lab, the rover has completed over 2.5 km traverse over often difficult terrain. Over 120 Gb of data was collected to be used for later analysis and training data for navigation.

BEAST is fully electric and runs on battery power. For future tests, the objective is to characterize the power profile, endurance and in-field recharge capability with the aim of all-day long continuous operation.

Moreover, the rover will run GMV's cutting edge autonomous navigation software which empowers it to perform a traverse of 10s of km per day sustained. This novel system is aimed to be deployed fully autonomously in remote environments over long durations, monitoring infrastructure, mining operations, agriculture and similar remote sites (both space and terrestrial).

The revolution of miniaturization

In early June the Noordwijk (the Netherlands) headquarters of the European Space Research and Technology Centre (ESTEC) hosted the fourth CubeSat Industry Days. This biennial, three-day event, attracted a turnout of over 250, dealt with the latest technological CubeSat developments, ESA's activities in this field, the future priorities and the technical and legal challenges still to be met.

In recent years there has been a notable boom in this idea. Configurations ranging from 0.5U to 24U have been developed, supporting missions of scientific exploration, earth observation, navigation and technology demonstrators, among others. By now this technology has become a reliable, responsive and economical solution, making space access easier on the strength of its modular concept, design- and manufacture-standardization and system integration.

GMV took part in ESA's CubeSat related technology development activities, presenting the company's inhouse subsystems, products and technology developed for various projects such as RACE (Rendezvous Autonomous CubeSats Experiment), JUVENTAS (one of the two CubeSats making up the HERA mission) and the GNSS software receiver (GPS and Galileo). GMV also showcased the ground segment solutions providing these satellites' attitude and orbital control.

Successful validation of the future HERA mission's GNC on the *Platform-art*® testbed

■ GMV is leading the international consortium in charge of designing the guidance, navigation and control (GNC) system of the European Space Agency's HERA mission, led by OHB-System AG.

Picking up the baton from the Asteroid Impact Mission (AIM), HERA will be the first ever interplanetary space mission to visit a binary asteroid system, Didymos. The biggest asteroid measures 740 m in diameter, 40 times bigger than the Chelyabinsk superbolide that, in 2013, wreaked havoc over the southern Ural region. The smaller asteroid, orbiting the former like a tiny moon, has a diameter of 150 meters.

From May to June the mission's first Hardware-In-the-Loop (HIL) tests were held in GMV's *Platform-art*® testbed as in-orbit servicing validation scenario.

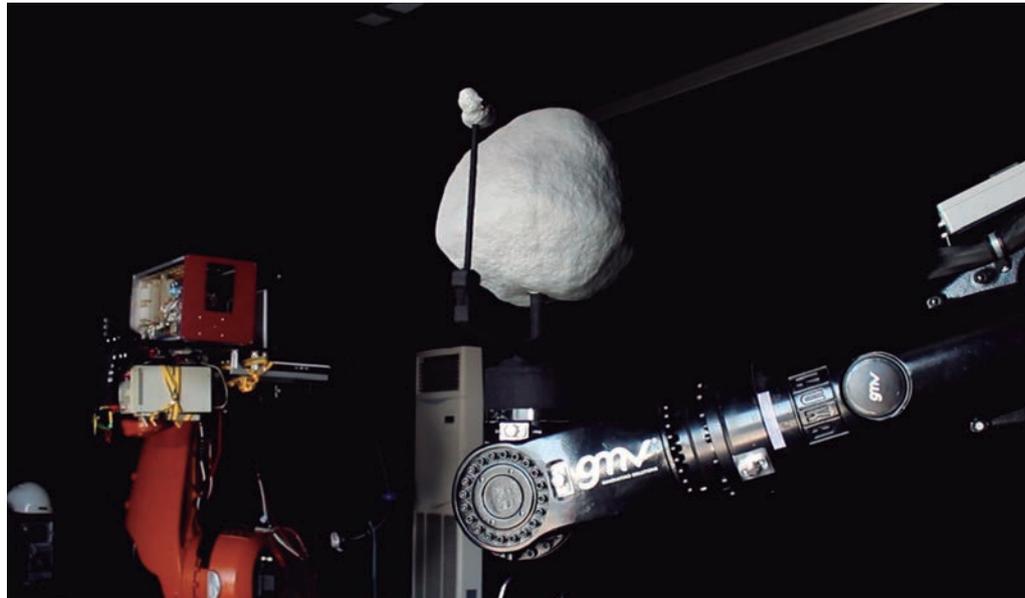
Platform-art® is a dynamic testing environment especially designed for prior ground testing of space-debris-capture, planet-surface-exploration, lunar-descent and flight-formation missions and systems.

To carry out HERA's tests an entirely GMV-designed autonomous guidance,

navigation and control (GNC) system was set up. These tests have been conducted by replicating a real HERA scenario with maximum dependability and precision. This involved the use of high-precision robotics arms, physical models of both asteroids generated by high-definition 3D printing techniques and diverse satellite systems, including a camera flight model and avionics systems mimicking the actual mission (computers, data exchange and communication protocols).

Nearly two months of tests have proven the validity, robustness and performance of the image-processing algorithms within the autonomous GNC systems. By pulling off this feat GMV has made an essential stride towards guaranteeing HERA's overall safety and success.

These tests mark the end of the mission's phase B1 software-integration and -development activities and now pave the way for phase B2



The role of robotics in flexible production

■ By 2020 the number of robots sold worldwide for industrial use is set to top 3 million. This figure sheds light on how the robotics and automation market is likely to develop in industry. This situation poses various challenges and also presents many opportunities for developing new market-adapted business models.

In Global Robot Expo, the international showcase of industrial innovation, automation and digital transformation, held in April, the Industry 4.0 Committee of the Spanish Association of Electronics,

Digital Contents and ICT Companies (*Asociación de Empresas de Electrónica, Tecnologías de la Información, Telecomunicaciones y Contenidos Digitales*; AMETIC) organized a discussion panel on Industry 4.0 technologies that are going to transform industrial plant.

During the debate Ángel C. Lázaro, Industry Business Partner of GMV's Secure e-Solutions sector, explained that the new market needs, demanding products and services with a high level of personalization, mean that production

lines now give more importance to such aspects as modularity and versatility. Robotics thus takes on a new dimension, working with new mechanisms for quick and easy switching of production routines.

GMV has been developing control robotics and algorithms for over 25 years now. Within this field we center on industrial robotics and autonomous robotics in hostile environments such as nuclear power plants, deep undersea work, space and other areas.

GMV talks about its experience in space-debris reduction and removal

From 9 to 10 July the Castelgrande Astronomical Observatory in Basilicata (Italy) hosted the “IAA Italian Regional Symposium of Space Debris Observations from Basilicata”, organized by the Group of Astrodynamics of the Use of Space Systems (GAUSS). This event forms part of “Matera 2019 – European Capital of Culture” and, for this reason, Castelgrande was awarded the title of “European Capital for a Day” at the opening of the conference.

Castelgrande Observatory, among other remits, forms part of the International Scientific Optical Network (ISON), carrying out activities of detection, observation and monitoring of both space debris and Near Earth Objects (NEOs) under the CastelGAUSS Project, doing so in cooperation with the Keldish Institute of Moscow (KIAM) and by agreement with the municipal district of Castelgrande.

Sponsored by the International Academy of Astronautics (IAA), this symposium sets out to address issues to do with the observation, prevention, mitigation and potential active removal of space debris in the most commonly used earth orbits (LEO, MEO and GEO), plus the observation of nearby asteroids.

Mariella Graziano, Executive Director of GMV’s Robotics and Flight Segment, gave a masterclass under the title “GMV experience on effective space debris monitoring, limitation and potential active removal”, based on GMV’s wealth of experience in this field.



GMV collaborates in UKSEDS’s robotics competition

■ GMV supported as official partner the “Olympus Rover Trials competition”, held from 21 to 28 July in the United Kingdom.

This competition, organized by UK Students for the Exploration and Development of Space (UKSEDS), is geared towards university students from the whole country, challenging them to design, build and operate a rover for the Mars return mission.

UKSEDS sets out to help and educate youngsters and inspire them towards space exploration and research. To do so the society organizes and runs a whole

host of activities. UKSEDS is the UK chapter of the global SEDS movement, working alongside sister organizations all around the world in Canada, Mexico, Nepal, Spain and the United States, among others.

The Olympus Rover Trials competition represents a great chance for students to learn how to work in a professional environment and see how the space industry works.

As part of this collaboration GMV handed out the competition prize to the Bath University team.



GMV showcases its breakthroughs in autonomy and robotics systems at ASTRA

GMV took part in the fifteenth “Symposium on Advanced Space Technologies in Robotics and Automation” (ASTRA), hosted by the European Space Research and Technology Centre (ESTEC) in Noordwijk, the Netherlands, from 27 to 28 May.

In this symposium, organized every two years by the Automation and

Robotics (A&R) department of the European Space Agency, GMV presented a total of 5 papers dealing with the results obtained in the ERGO, ESROCOS and FACILITATORS projects, the three robotics building blocks being led by GMV in the European Commission’s Space Robotics Strategic Research Cluster (SRC).



EUCCIS successfully participates in NATO's CWIX Interoperability Exercise

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

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

One of the main remits of the European External Action Service is to assist the High Representative of the EU for Foreign Affairs and Security Policy, to which post Josep Borrell has recently been appointed, due to take up his office wafter European Parliament approval.

EEAS is now redefining and reinforcing its structures and capabilities to enable the EU to react more quickly, efficiently and effectively as a provider of security services outside its borders. These operations cover the whole gamut of crisis prevention, management and response, ranging from humanitarian aid, civil protection, support for the stabilization and restructuring of conflict zones and evacuation of European citizens.

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

CWIX (Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise) is NATO's biggest interoperability event, held annually in NATO JFTC (Joint Forces Training Centre) in Bydgoszcz, Poland.

As a result of the upgrading of EUCCIS in the first two years of the GMV contract, by the time CWIX 2018 came around EEAS had already decided to take part for the first time as mission partner with complete involvement in the exercise network (NATO classified Network Combined Federated Battle Laboratories Network -CFBLNet), having taken part in previous years as observer only.

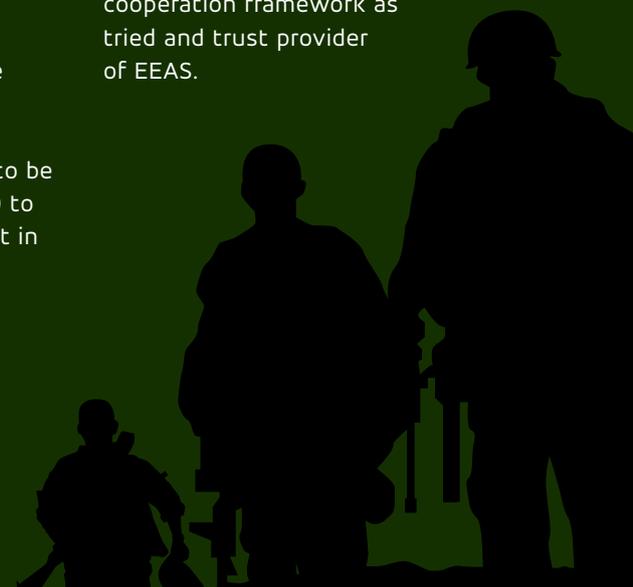
Given the success of this first participation, EEAS has now decided to reinforce its role in CWIX 2019, calling for a concomitant increase in support by team GMV.

In the second half of 2018 and the first half of 2019 GMV's team has phased in the additional EUCCIS capabilities deemed by the EEAS to be of interest for CWIX 2019. From 10 to 21 June 2019 a GMV team took part in CWIX 2019 with great success.

Interoperability with command and control systems of the main participating countries was successfully proved. The chat

developed by GMV was also federated with the United States and France. Lastly, the new tactical visor on which GMV has been working since the very start of its EUCCIS activity, replacing the previous visor, was used as provider and consumer of geographic information systems with other systems. EEAS will in fact take on responsibility for the following exercise of leading the GEOMETOC functional area (geographical, meteorological and oceanographic data).

These activities fall under the seven-year framework contract on which GMV is working as sole contractor. GMV's experience in communications and information systems (CIS) for command and control now enable it to take charge of this whole range of activities, confirming the establishment of a long-term cooperation framework as tried and trust provider of EEAS.



Europe's top maritime-safety representatives meet up in the 2nd MARISA Workshop

■ On 21 May, under the umbrella MARISA project (Maritime Integrated Surveillance Awareness), GMV put on the 2nd MARISA Workshop in Madrid.

The main aim of this project, which kicked off in May 2017, is the integration of Big Data with multi-sensor data-fusion; this groundbreaking technique involves the mining of data from different sources to glean useful, top-quality information, applied in this case with maritime security in mind. This will be possible thanks to the development of a set of interoperable tools for easy

access of the data generated by the various technological resources now up and running.

The Horizon-2020 MARISA project involves a consortium in which the Italian multinational Leonardo is leading another 21 companies from 9 EU member states. GMV is one of these partner companies, playing a standout role in the project. It is responsible for system design, the development of anomaly-detecting and level-1 data-fusion algorithms, as well as carrying out the integration and operational trials.

The workshop explained the system's various services and weighed up the results of the first operational trials held during 2018 in the project's five scenarios: North Sea, Iberian Peninsula, Aegean Sea, Ionic Sea and the Strait of Bonifacio, with standout roles being played by the Portuguese Navy, the Spanish Guardia Civil, the Greek MoD, the Italian Navy and French Navy, all of whom swapped notes and took stock of MARISA as it stands.

The workshop, attracting a turnout of over 40, completely fulfilled its aim of setting up a stakeholder debating forum about the potential use of MARISA's tools and functions as well as its interoperability with the other solutions currently available throughout Europe.

The guests included representatives of the Spanish and French navies, the Romanian coastguard, the European Organisation for Security (EOS), the Swedish Defence Research Agency (Totalförsvarets forskningsinstitut: FOI), the public finances service of Belgium, the European Joint Research Centre (JRC) and coordinators of the European SAURON and RANGER projects.



Defense and Security R&D

The Polytechnic University of Madrid (*Universidad Politécnica de Madrid*) and the Spanish Strategic Studies Institute (*Instituto Español de Estudios Estratégicos: IEEE*), under the aegis of the Spanish MoD, have put on the fifth summer course "Impact of Artificial Intelligence on Defense and Security", held from 2 to 4 of July in the Higher Center for National Defense Studies (*Centro superior de Estudios de la Defensa Nacional: CESEDEN*).

The three-day course addressed the strategic lines of Artificial Intelligence and Big Data R&D as applied to defense technology and infrastructure.

Manuel Pérez Cortés, GMV's General Manager of Defense and Security, gave the lecture on "Intelligent data processing in defense systems" within the industry-focused block of lectures. He spoke about GMV's AI activity, not only in security systems for FRONTEX,

like ISR, but also in command and control systems for the Ministry of Defense. He stressed the need for explicability of AI-based solutions, especially in critical systems.

This course comes under the «General Engineer Antonio Remón y Zarco del Valle» Chair of Defense Studies, officially approved by the Spanish government for teaching and research and any other related activities of interest.



GMV hands over to Navantia the prototype navigation system to be integrated into the F-110

■ Under a contract with Navantia GMV is developing for the Spanish navy a prototype SENDA navigation system for the F-110 frigates.

The future F-110 frigates will replace the current Santa María class frigates, which have been carrying out escort duties since the mid-eighties of last century. The new frigates have been jointly designed by the Navantia shipyard and the Spanish Navy. The program comprises a multi-mission design with a variety of capabilities ranging from undersea and surface warfare to asymmetric warfare and anti-aircraft defense.

The main objective of the SENDA navigation system is to provide a national solution for the frigate F-110's navigation system with functions analogous to those of the American NAVSSI system fitted on F100 frigates but with substantial upgrades due to

the incorporation of new navigation technologies and systems such as detection of jamming and spoofing and the incorporation of a Galileo Public Regulated Service (PRS) receiver.

After successful conclusion of the system's Factory Acceptance Tests (FAT) on 25 July the prototype was handed over to Navantia on its San Fernando (Cádiz) site. The prototype, which will remain on Navantia's site for objective assessment, will then be integrated in the F110 frigate's Land Based Test System (LBTS) with the idea of starting in September the on-site acceptance tests (OSAT).

The SENDA navigation system has been developed on a groundbreaking modular design to isolate the mission system from the navigator configuration. This modular design incorporates multi-constellation fusion technology and

The prototype, which will remain on Navantia's site for objective assessment, will then be integrated in the F-110 frigate's Land Based Test System (LBTS)

GNSS/INS, making this navigator a robust and versatile solution that outperforms the rest. Furthermore, SENDA works as a timing source for the rest of the frigate's systems, incorporating for that purpose a time synchronization server and a pulsed light source that can be extended to various distribution protocols, for any equipment that needs greater precision in the timing signal.

In the coming months due approval of the development of the F-110 frigates is likely to be followed by activation of final SENDA system development.



GMV completes the VCR 8x8 navigation system

■ During 2019 work will continue on subsystem qualification tests to prove compliance of the Spanish army's wheeled combat vehicle (VCR in Spanish initials) 8X8 with technological program rules. Meanwhile GMV has completed design of the vehicle navigation system, kicking off the manufacturing phase of the subsystem's operational units.

GMV has developed a vehicle navigator based on a hybrid architecture of inertial navigation and satellite navigation, integrating an inertial navigation unit and a multi-constellation receiver (GPS, Galileo and GLONASS) and with the capacity for phasing in the future signal receiver of Galileo's Public Regulated Service (PRS) PRESENCE 2, being jointly developed by GMV.

The GMV-developed ISNAV system is an advanced navigation and timing solution for armed-forces vehicles, combining the aforementioned satellite-navigation features and also guaranteeing compatibility with external inertial navigation systems (INS), permitting



robust navigation in covered zones and theaters debarred to satellite navigation (jamming).

ISNAV also works as a timing source for the vehicle network. For this task it includes a timing server for synchronization of onboard equipment

and a pulsed light source synchronized with UTC time for equipment needing greater precision in the timing signal. ISNAV offers an acceptable data output, meaning that the timing, positioning, speed and orientation system can be used by the diverse configurations of the VCR 8X8 vehicles.

GMV features at FEINDEF

■ On 31 May the first International Defense and Security Fair (*Feria Internacional de Defensa y Seguridad: FEINDEF*) closed its doors after attracting over 150 exhibitors from 11 different countries and a bumper turnout of 10,000. Held in Madrid from 29 to 31 May, it was organized by the Spanish Association of Space, Aeronautics and Defense Technology Companies (*Asociación Española de Empresas Tecnológicas de Defensa, Aeronáutica y Espacio: TEDAE*) and the Association of Government Contracting Firms (*Asociación de Empresas Contratistas con las Administraciones Públicas: AESMIDE*) with the collaboration of the Spanish MoD.

GMV ran a stand showcasing its groundbreaking defense and security developments.

GMV also took the chance to exhibit on its stand the unmanned aircraft Seeker, an autonomous, rapid-deployment system for surveillance and reconnaissance missions developed for its partner AUREA Avionics, plus the Dismounted Soldier system SISCAP developed for the Spanish MoD's DGAM in a joint venture with Indra.

During the event GMV's stand was visited by various leading figures and authorities such as the Minister of Science, Innovation and Universities, Pedro Duque; the Secretary of State for Defense, Ángel Olivares; the Director General of Armaments and Material, Santiago Ramón González; the DGAM's Assistant Director General of Planning, Technology and Innovation; the Airforce Chief of Staff

(*Jefe del Estado Mayor del Aire: JEMA*), Javier Salto and the Director of OCCAR, Arturo Alfonso Meiriño. Other stand visitors included diverse international delegations such as NSPA, Arab Emirates, Argentina, Colombia, Chile, Peru and Bulgaria.

As the recent winner of the European Space Agency (ESA) contract for maintenance and upgrading of the Galileo Ground Control Segment (GCS), GMV was also present at the event held on GOVSATCOM's stand to showcase the Ministry of Defense's burgeoning space capabilities. Last but not least, the Spanish Navy's stand featured the SENDA navigation system to be fitted on F-110 frigates and developed under a contract with NAVANTIA.



GMV phases ASCA capability into TALOS

■ The Subdirectorate General of Armament and Material Procurement of the Directorate General of Armaments and Materials (DGAM) has awarded GMV the contract for implementation of ASCA capability into the TALOS artillery system.

TALOS, designed by GMV in 2010, is a C4I system for the planning, management and execution of all fire support that might be received by any brigade: field artillery, mortar fire, naval fire support and air support for ground operations.

TALOS capabilities include fire-support and maneuver planning with support tools for choice of the line of action, conducting of the maneuver with integrated fire support, friendly force tracking (FFT) and monitoring of maneuver tactics, obtaining targets, fire management and fire execution and observation, up to arms-system level in the case of mortar and field artillery fire.



The ASCA group (Artillery Systems Cooperation Activities), currently made up by USA, Turkey, Denmark, Germany, France, Italy, the Netherlands, Norway and the UK, defines procedures and a digital interface linking member countries' fire support systems to achieve automatic execution of indirect firing procedures.

With the addition of the new ASCA capability the TALOS system will

overcome the language barrier and cut down the reaction time.

The feeding in of this new capability forms part of the improvements and updates that GMV has been phasing into the system over the years. This new capability will also consolidate the TALOS system at worldwide level and enable the Spanish artillery to take part with TALOS in international maneuvers like Dynamic Front and Bold Quest.

GMV supports NATO's latest cyberdefense conference



Building upon the encouraging results of the latest NATO CD SDP Conference the 5th in the series was held in Amadora (Portugal) on May 16.

The event represents an unusual opportunity of exploring new ideas: from

harmonizing requirements to delivering operational capabilities; from research and innovation to transformation; from education, training and exercises to maintenance and support for operations, and reinforcing the complementarity of NATO-EU efforts in the field of Cyber Security and Cyber Defense.

In line with this idea, Cyber Defense related Projects (MNCD2, MISP and MNCDE&T) are strongly committed to join efforts and work together with industry and academia, building the necessary bridges between international and national initiatives.

GMV was once again one of the main sponsors of the NATO CD SDP Conference, presenting its range

of added-value products in the Cybersecurity sector and showed how the latest Cybersecurity and Cyber defense breakthroughs might help to meet the current challenges faced by the different state security corps and forces.

This event aimed to offer a free, open and wide discussion forum, providing industry and academia with a unique opportunity to present and discuss new ideas, solutions and technical capabilities.

Marcelo Rebelo de Sousa, Head of the Portuguese State, also attended the event and stressed the vital importance of the meeting on the current topic of Cybersecurity.



Reinventing ATMs to bring them into line with the digital transformation

Drawing on its wealth of Cybersecurity experience, GMV is collaborating in an ATMIA initiative (ATM Industry Association) that seeks greater synergy between ATMs and cell phones on a worldwide level

We are now living in a digital era in which organizations have to cope with an ever-changing environment bristling with challenges and opportunities. Businesses and companies across the board are joining in the digital

revolution, creating new ecosystems based on disruptive business models and groundbreaking technological solutions adapted to suit their particular needs in each case. In the financial sector, the first ever ATM was installed over 50 years ago in a branch of Barclays Bank;



since then it has been able to keep up with generational changes in order to offer customers the best possible service.

At the moment, and probably for the foreseeable future, the cell phone is the number-one consumer technology, and ATMs risk losing part of their attractiveness for millions of consumers unless they are capable of connecting up with these handhelds. Mindful of this, the ATM Industry Association (ATMIA) has set in motion a project to create a next gen API App with worldwide ATM interoperability. This initiative will usher in a complete reinvention and rebirth of the ATM industry, with the overarching aim of pulling off a synergy between the world's 3.2 million ATMs and 5 billion+ cell phones.

The project, known as "ATMIA Next Gen Champions", comprises a consortium of over 200 ATM deployers, vendors and

suppliers. GMV is collaborating in this initiative, inputting its view of what Cybersecurity should look like in this new model, where the mutual interoperability of ATMs and cell phones opens the door to new risks that we must know how to tackle from day one.

The aim is to ensure that ATMs can play a full part in banking's digital transformation without forfeiting innovation or curbing competitiveness while also addressing any obstacles by dint of research, analysis and consensus-building.

For years now GMV has been giving banks a practical vision of how to assess, design, set up and vet the most advanced and cost-effective Cybersecurity measures. More than a decade ago now GMV was given a challenge; equip ATMs with software to protect them from cyberattacks, which, back then, were

then just beginning to rear their heads. Peerless research, development and collaboration then gave birth to **Checker ATM Security**, the specific ATM solution that is now protecting nearly 200,000 ATMs of 60 clients from 30 countries around the world.

The cell phone is the number-one consumer technology, and ATMs risk losing part of their attractiveness for millions of consumers

How to deal with cyber risks in a changing socioeconomic context



■ At the end of May, the 21st International Information Security Conference, organized by ISMS Forum under the banner title “Cyber Risk Appetite in the new Digital Revolution”, brought together top sector experts to talk about the key issues of tackling the new cyberthreat scenario. Attention was focused on the impact of

Cybersecurity policies and protection of personal data in their ongoing interaction with the digital revolution now faced by the business sector and the assumable risk in the inevitable drive towards innovation and process automation.

Mariano J. Benito, GMV’s CISO and CTO Coordinator of Cloud Security Alliance

(CSA) Spain, gave a paper together with Linda Strick, Managing Director of Cloud Security Alliance EMEA. Both stressed the importance of the new General Data Protection Regulation (GDPR) Center of Excellence for cloud computing. This center will be coordinating GDPR activities at world level, focusing initially on GDPR compliance by European member states and bringing the certification framework into line with its needs.

Great expectation was also aroused by presentation of diverse studies and projects such as the first DPO White Paper in Spain and also the first Guide created in Spain for Application of the Data Portability Right. The former is a document that aims to serve as reference for defining the role of the Data Protection Officer in Spain, while the latter serves as a repository of simulated good-practice cases in exercising the data portability right.

Cybersecurity to the fore for the protection of critical infrastructure



Application of new technology to the everyday activities of companies and public organizations has turned into a great chance of enhancing process efficiency, with the downside of much greater vulnerability and exposure than in past years. During the 2nd

Cybersecurity Forum, organized by El Economista with the sponsorship of GMV and Oracle, experts spoke about the need of raising awareness of the risks posed by new technology and the importance of cross-the-board education and instruction in a good use of this technology.

The event’s opening address was given by the Director of the National Cybersecurity and Infrastructure Protection Center (*Centro Nacional de Protección de Infraestructuras y Ciberseguridad*: CNPIC), Fernando J. Sánchez, who stressed the increase in cybercrime in Spain and the importance of understanding Cybersecurity from a holistic viewpoint as part of an overarching security strategy. Sánchez also quoted striking facts and figures

on this matter: according to records of the Ministry of the Interior, 111,000 cybercrimes were committed in 2018, almost double the 2016 figure of 66,000.

Javier Zubieta, Marketing and Communication Manager of GMV’s Secure e-Solutions sector, shared a discussion panel with the CISOs and CIOs of Globalia, Atresmedia, Correos Express and Viesgo. His speech focused on notable developments such as the growth of Cybersecurity investment, GMV’s European Space Agency contract for maintenance and upgrading of the Galileo Ground Control Segment (GGCS), in which 30% of the budget, amounting to 250 million euros over three years, will be spent on guaranteeing GGCS Cybersecurity.



Main requirements for security accreditation of classified missions



■ The 7th European Ground System Architecture Workshop (ESAW) provided an international forum for system architects to swap ideas constructively and anticipate future technological trends in system architecture of operational data, such as: mission control, mission planning, data analysis, flight dynamics or the back-end of ground stations. Julio Vivero, Business Partner of GMV's International Sector,

gave a paper on security accreditation for classified missions.

Quite often, part of the mission data used or exchanged is considered to be classified by the European Union. In such a case the security mission has to be accredited, bearing in mind a series of implications that need to be known and met before the mission can be cleared for going ahead. Vivero's speech

described the main requirements for the clearance of missions processing EU Classified Information (EUCI). This clearance is in turn granted by a Security Accreditation Authority (SAA), which is assigned to the mission concerned in light of various factors. In general the National Security Agencies (NSAs) of the member states involved in processing the EUCI mission infrastructure also take part in the process.

International Cybersecurity Training Initiative

■ At the end of May Spain's National Cybersecurity Institute (*Instituto Nacional de Ciberseguridad*: INCIBE), in collaboration with the Organization of American States (OAS), organized the fourth Cybersecurity Summer BootCamp, an international Cybersecurity training program directed at members of security forces and corps, computer emergency response teams (CERTs) and professionals from the judicial and public-prosecutor sectors.

The event's main goals are to provide training in the latest techniques in the fight against cybercrime, management of Cybersecurity incidents and the legislative aspects to be taken into account in all these endeavors, as well

as improving coordination in dealing with cybercrimes and incidents.

Hands-on workshops were run by top Cybersecurity professionals. Isidro Ramón Labrador, Head of Section of GMV's Consultancy Division, was invited to run the workshop "Introduction and general concepts (Internet Architecture, Operating Systems, Cybersecurity)", directed at members of Cybersecurity forces and corps who are fighting cybercrime.

Cybersecurity Summer BootCamp made Spain a worldwide Cybersecurity cynosure and also enabled it to forge even closer bonds with other countries.





Cybersecurity challenges, threats and solutions in the financial sector



■ The financial sector has made more headway than most in the digital transformation, with knock-on changes both in the structure of banks and the behavior of their customers, who are becoming increasingly used to online banking transactions. For this transformation to be successful, however, there is a need not only for big ICT outlays and changes in business cultures but also

a systematic approach to various challenges and threats.

One of the outstanding challenges is the security of banking transactions and data stored in banks' information systems. So important is this issue that in June the Defense and Security Technology Foundation (Fundación Círculo de Tecnologías para la Defensa y la Seguridad)

held a conference to bring together senior politicians and experts from state security forces, companies and financial professionals to take stock of the current state of threat-forestalling technology and tools and their likely future. GMV's Roberto López, Financial Manager of GMV's Secure e-Solutions sector, analyzed the challenges, threats and solutions of the sector.

GMV participates in the Cybersecurity conference put on by ICEX and INCIBE in Colombia

Colombia's Cybersecurity sector has been chalking up impressive growth rates in recent years. In the public sector 2019



has so far seen a 13% investment rise in projects carried out by the Ministry of Information Technologies. In the equally buoyant private sector pride of place goes to the banking sector's digital transformation initiatives, backed up by a higher Cybersecurity awareness in other companies.

In view of this situation Spain's Foreign Trade and Overseas Investment Institute (ICEX *España Exportación e Inversiones*) and the National Cybersecurity Institute (*Instituto Nacional de Ciberseguridad*: INCIBE) put on a Cybersecurity conference

that brought together Spain's leading Cybersecurity firms trading in the Colombian market, GMV to the fore. The aim was to bring out the business-, cooperation- and investment-opportunities offered by Colombia's Cybersecurity market.

Victor Gaspar, Country Business Manager of GMV's Secure e-Solutions sector in Colombia, took part in an expert defense panel. After the papers there were bilateral meetings between the Spanish firms signed up for the conference and representatives from Cybersecurity-demanding Colombian firms.



The NAVIPHY project celebrates its first anniversary

The partners of the NAVIPHY research project, run by a consortium including GMV, meet up to take stock of the work carried out in this previous year and agree on the best way forward



On 29 May representatives of the various working teams of the research project “Navigation, physical simulation and imaging in intraoperative procedures”, shortened to NAVIPHY, met up in GMV to take stock of the work carried out in the first year of the project and agree on the best way forward.

NAVIPHY is a one-million-euro, 45-month project falling within the Ministry of Science, Research and Universities’ research challenges R&D call and subsidized by the European Union through the European Regional Development Fund (ERDF).

The project is being carried out by a consortium made up by GMV, the Research Institute of the Hospital Universitario La Paz (IdiPAZ), the Virtual Reality and Modelling Group (Grupo de Modelado y Realidad Virtual: GMRV) of the Universidad Rey Juan Carlos and the Canary Island Healthcare Research Foundation (*Fundación Canaria de Investigación Sanitaria: FUNCANIS*).

NAVIPHY’s purpose is to achieve greater precision in brain, breast and maxillofacial surgery, “developing surgical simulation algorithms and exploring the use of intraoperative imaging to upgrade the surgical simulator we have developed”, explains Carlos Illana, GMV’s Head of Product.

Information technologies and precision imaging now enable surgery procedures to be planned and simulated beforehand and can also guide specialists during the actual surgery, in both cases helping to improve results. Nonetheless, when dealing with soft tissues like the brain, there remains some work to be done in order to be able to help surgeons operate with greater precision. Collaboration between healthcare and technological personnel, as is the case in NAVIPHY, is crucial here. After all, one of the biggest challenges of image-guided surgery is

precise modeling of any changes to the patient’s anatomy during the operation. To achieve this it is necessary not only to develop surgical-simulation algorithms, in order to ensure greater control of the surgical procedure and result, but also to build up clinical expertise and interpretation skills in order to guide the research while also assessing and vetting the applicability of all developments.

To this end the consortium’s multidisciplinary team is now working on evaluation of the use of intraoperative images when radiotherapy is being administered to the cancer site after tumor removal within the operating theater. It is likewise exploring the use of multimodal imaging techniques (CT, ultrasound, etc) for a better anatomical representation of patients as well as surgical navigation tools to facilitate up-to-date and individualized information, thus progressing towards personalization of the treatment.

GMV, in collaboration with the specialists Pedro Lara and David Macías, has developed a surgical-navigation module in the intraoperative radiotherapy device **Radiance™** in order to guide breast cancer surgery and application of intraoperative radiotherapy, in use now for two years. In the NAVIPHY project GMV is tackling the challenge of creating adaptations for other complex surgical procedures such as maxillofacial and brain in which precision is a sine qua non of success.



GMV's telemedicine solution, *Antari*, goes from strength to strength in Colombia

■ GMV's inhouse telemedicine platform, **Antari**, is going from strength to strength in Colombia, with the collaboration of its technology partner for the provision of telehealth services, Thot Salud S.A.S., a company belong to the Campbell business group.

Antari enables the Fundación Clínica Campbell (www.clinicacampbell.com.co) to provide its patients with 24 x 7 healthcare. Family physicians working from **Antari** equipped health centers can communicate with the specialists required in each case to give a precise diagnosis based on teleconsultations.

Working through Thot Salud S.A.S, Campbell Group, specializing in post-accident orthopedic surgery and traumatology, has now opened three offsite health centers, two in the city of Soledad -in the health centers called "Centro de Salud 13 de Junio"

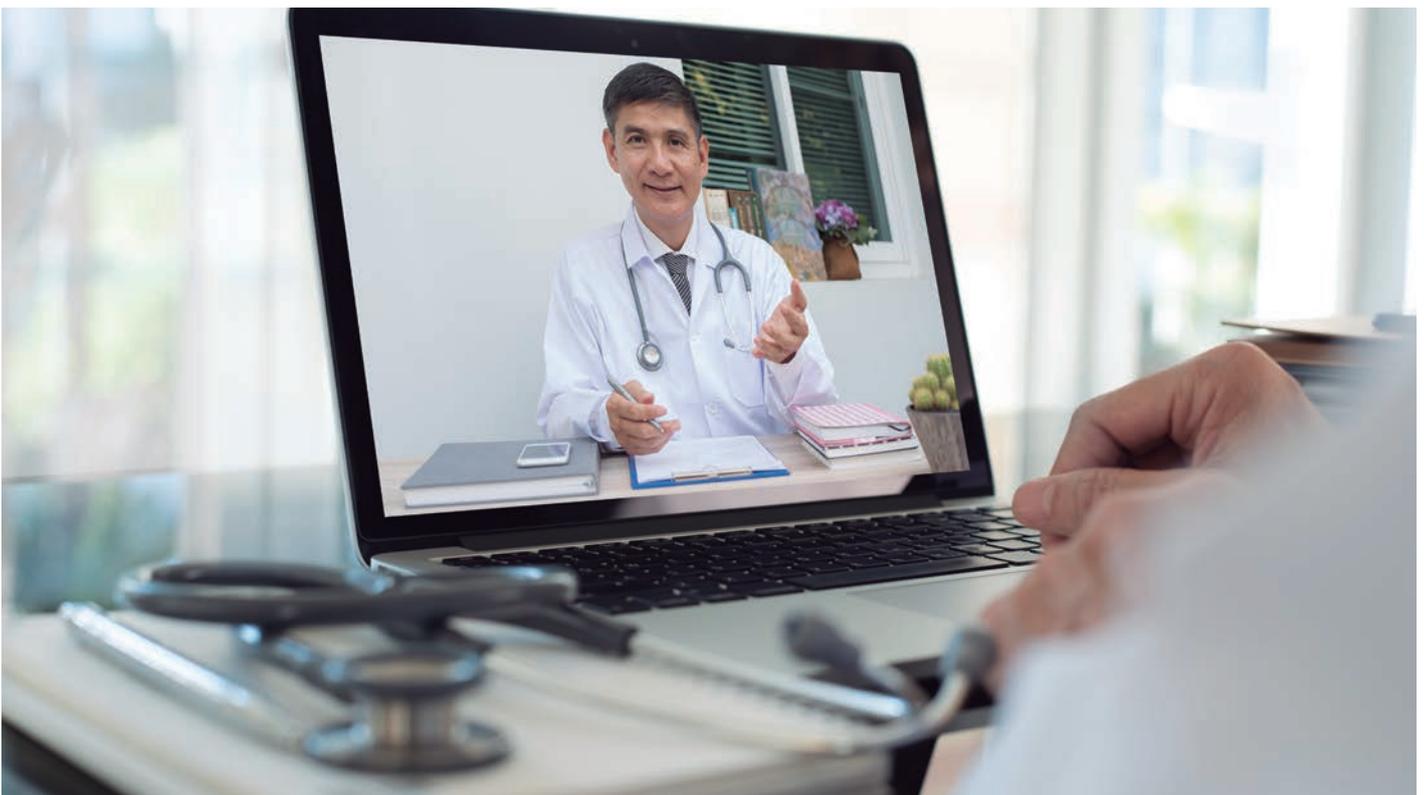
and "Ciudadela metropolitana"- and a third in the city of Sabanalarga. In all these clinics GMV's telemedicine platform, **Antari**, allows offsite medical attention to be blended with traditional onsite attention, giving patients access to specialists without needing to travel to their premises. As the Colombian group has announced "a fourth center is soon to be opened and the aim is eventually to set up 31 **Antari** enabled health centers nationwide".

In the words of Doctor Anny Toscano, healthcare manager of Fundación Clínica Campbell, "**Antari** user feedback is excellent and we can now reach further afield and make better informed referrals. As of today, 200 visits a month are being clocked up".

As Víctor Gaspar, General Manager of GMV Colombia, points out, "**Antari** meets the market's strictest

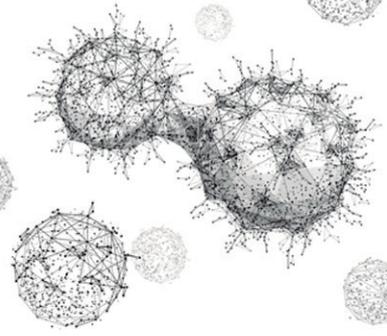
interoperability and security standards (privacy, confidentiality) and interoperability for all-in management of teleconsultations". He adds, "It helps clinics draw up better-balanced agendas of teleconsultations and onsite medical appointments. It also takes in organizational aspects such as management and resource-tracking, health planning and appointment management".

Antari, allows offsite medical attention to be blended with traditional onsite attention, giving patients access to specialists without needing to travel to their premises





GMV algorithms guide operating surgeons and oncologists



GMV's IORT planner, **Radiance**, features in the latest Health IT, an event where healthcare and IT experts came together to look at digital progress within the healthcare sector

On 25 June the cutting-edge hospital Fraternidad-Muprespa Habana was the venue for Health IT 2019, put on by IDG Research to allow healthcare and IT experts to give their takes on digital progress within the healthcare sector.

Top specialists from radiation oncology, neurosurgery or hospital management like Pedro Lara, Marisa Gandía or Bernardo Valdivieso, among others, debated the digital progress being made by the healthcare sector, doing so together with GMV, hospital CIOs and analysts of IDG Research.

The event was led by Fernando Mugarza, manager of corporate development and communication of Fundación IDIS, who argued that “the digital transformation and artificial intelligence are both making increasing headway although their ongoing incorporation into organizations’ systems and processes remains a daily challenge. Their impact is obvious on the improvement of management and as an aid tool to clinicians in diagnosis and treatment”.

For his part, Alberto Bellé, IDG analyst, pointed to the convergence of the physical and digital as one of the major sector trends.

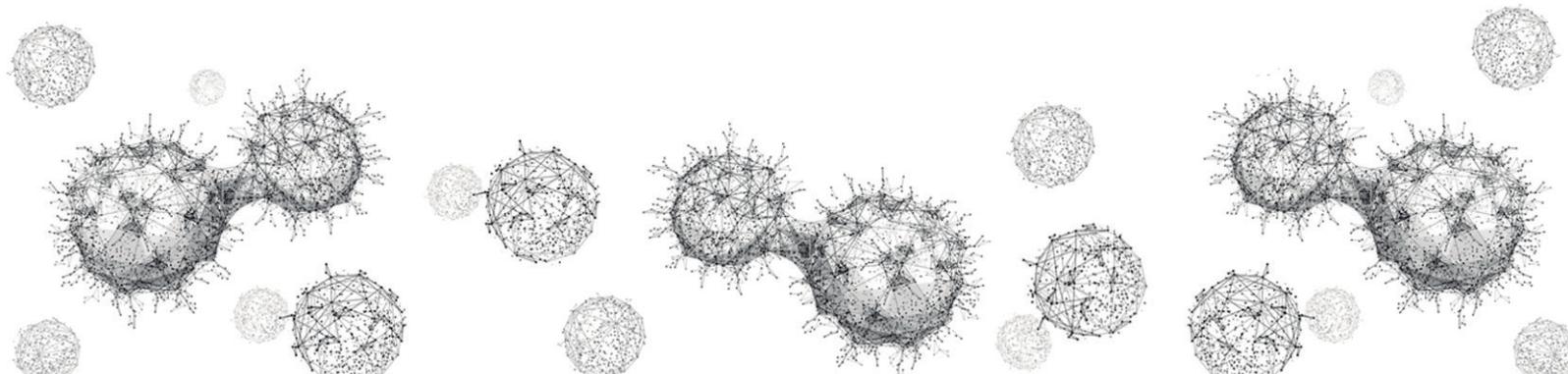
Carlos Illana, Head of Product at GMV, Marisa Gandía, neurosurgeon of Hospital Universitario La Paz and Professor Pedro Lara explained the benefits of surgical navigation, agreeing on the need of increasing takeup in hospitals as an essential precision-improving tool. These benefits are now being brought in by engineering developments like NAVIPHY, a GMV-led project involving also the participation of the Research Institute of the Hospital Universitario La Paz (IdiPAZ), the Virtual Reality and Modelling Group (Grupo de Modelado y Realidad Virtual: GMRV) of the Universidad Rey Juan Carlos and the Canary Island Healthcare Research Foundation (Fundación Canaria de Investigación Sanitaria: FUNCANIS).

Illana specifically held up GMV's IORT planner **Radiance** and also the fine results being obtained by the team of Pedro Lara and David Macias in the planner's application to breast

cancer treatment. Lara expressed his firm conviction about “the payback of healthcare technology investments, both for the system and for patients”. He explained how clinical oncologists, radiotherapists, are playing a central role in oncological treatment and insisted on the need for evidence-based data to provide solid information guaranteeing that cancer patients have access to radiotherapy.

For her part, Marisa Gandía explained how her specialization in minimally invasive surgery of the spine enables her to carry out less aggressive and painful surgery with excellent results for her patients. “Today, on the strength of precision technology, our reports indicate that we have performed ultrasound-controlled navigator-guided surgery”.

Some of the main goals that GMV's digital healthcare engineers have been working towards are to achieve greater precision in tumor removal and to provide surgeons, radiation oncologists and radiotherapy physicians with technological tools for digitalizing operating theaters with certainty and higher success rates.



Radiance at the latest ESTRO

■ The 38th congress of the European Society for Radiotherapy and Oncology (ESTRO 38) gave GMV and its **Radiance**-marketing partners Carl Zeiss Meditec and IntraOp the ideal chance to bring GMV's intraoperative radiotherapy planner to wider notice and talk about the IORT breakthroughs of the last year.

Carl Zeiss Meditec, in particular, showed the advantages of the use of Intrabeam and radiance in the treatment of glioblastoma, an especially aggressive brain tumor, and also in bone metastasis in the vertebrae, after due testing by collaborating clinicians. IntraOp, for its part, showed the benefits of administering IORT together with its solution based on a linear electron accelerator, MOBETRON, top-quality intraoperative imaging equipment, together with **Radiance**.

In the words of Carlos Illana, head of the radiance product, "this congress is presenting the latest breakthroughs at world level. And from everything we've learned along the way, two of the most important aspects are, firstly, the trend of applying Deep Learning technology in radiation oncology research, especially for automated segmentation tasks, cutting down the volume contouring time, and, secondly, the growing takeup of very high-dose



flash therapy, which acts directly on the tumorous tissue, saving healthy tissue from any harm".

The European Society for Radiotherapy and Oncology (ESTRO)

aims to reinforce radiation oncology by 2030 as a main partner in multidisciplinary cancer treatment, guaranteeing patients' access to top-quality radiotherapy on a needs-first basis.

GMV helps to ensure data privacy at ECSO and HIMSS

■ GMV shared its Cybersecurity expertise at the European arm of the world's largest health IT membership organization, HIMSS (Healthcare Information and Management Systems Society).

In the Health 2.0 Conference held this year in Spain, Julio Vivero, International Business Partner of GMV's Secure e-Solutions sector and secretary of the healthcare subgroup of the European Cyber Security Organisation (ECSO), stressed some of the conclusions drawn in ECSO's healthcare Cybersecurity report. One of the issues addressed was the

need of design-up Cybersecurity right from the start of any development, and the creation of a Cybersecurity certification or stamp to vouch for this.

Other issues included the need of driving a cultural change in healthcare Cybersecurity; the progress of the Konfido project for the creation of a platform to overcome the limitations of epSOS and ensure that healthcare data (medical records) are exchanged and accessed in a secure manager by EU member states; and security in network-connected medical devices. ECSO is a European-Commission-

brokered public-private association that sets out to identify Cybersecurity training needs.

GMV, as a member of ECSO, is helping to encourage cooperation between public and private stakeholders in the first stages of any research and innovation project, with the aim of providing European citizens with access to groundbreaking and trustworthy solutions (ICT products, services and software) while always ensuring the privacy of personal data, a right that really comes into its own when dealing with healthcare data.



GMV to develop ITS in Toruń, Poland

GMV and the City Council of Torun sign a contract under which the Polish city plans to expand the functions of the currently operating system, including, among other features, a new program to create the topology of the city's bus- and tram-lines

On 4 July GMV signed a contract with the City of Toruń (Poland) for development of a fleet management and passenger information system. The company will extend the functions of the currently operating system as well as bringing the public transport bus fleet into the ITS system.

This is not the first time Toruń has shown its trust in GMV. In 2014 the company fitted a passenger information system in the city's tram fleet. It includes onboard computers with a GPS locator in 51 vehicles, a central system for managing the public transport fleet, as well as 67 boards displaying updated tram departure times and any delays. Travelers can also use a bus-stop search engine and dynamic passenger information on the website to gain real-time public-transport information in their city.

Under this new agreement the city of Toruń plans to expand the functions of the currently operating system with – among other features – a new program for creating the topology of the city's

bus- and tram-network. This solution will optimize fleet use, ensure efficient scheduling of crew shifts and speed up timetabling. The website will be complemented by a handheld app that includes a travel planner, notifications of changes in the functioning of public transport and the option of saving preferred stops as favorites.

The other part of the contract is inclusion of the city's bus fleet in the passenger information system.

The scope of this project includes delivery, assembly and commissioning of onboard devices in 115 public transport buses with driver consoles. Ensuring communication between the dispatcher's office and the driver will improve the punctuality of the transport network, and in the event of heavy traffic, it will help to develop alternative travel routes on an ongoing basis. Users will be informed about changes by 73 new passenger information boards with a voice module.





GMV takes on ITS maintenance of Cyprus's public transport fleet

The project includes maintenance of all technological equipment and of the software set up on Cyprus's bus fleet, including the advanced fleet-management system, the passenger-information system and the ticketing system

In 2016 GMV won the contract for modernization of Cyprus's public transport. Since then the project has passed through various phases such as implementation, warranty and now stands in the seven-year maintenance period.

GMV's project includes the supply, installation and integration of all necessary software and technological equipment for Cyprus's fleet of

public-transport buses, including advanced fleet-management and public-information systems as well as the fare system.

The fleet-management and passenger-information system keeps up a permanent GPS tracking of all buses while maintaining permanent communication between bus drivers and the control center, swapping information on such varied factors as incidents, the running timetable, personnel services, etc.

Passenger information on the exact arrival time of each bus is given on 30 electronic panels installed in bus-stations and on the cities' main bus-stops. This same information is then replicated in an App and user website.

The payment system, for its part, caters for the use of paper tickets and single-use ultralight farecards to phase out the traditional cardboard cards with barcode or magnetic band. The smartcard used is a rechargeable MIFARE DESFire EV2, a



technology that guarantees a rapid and secure payment service.

Maintenance is based on a plan drawn up since the very start of the project, involving mainly preventive maintenance and corrective maintenance supported by a 7x24 on-call service to deal with any critical incidents that may occur outside normal working hours.

The main device for monitoring compliance with this plan is an inhouse GMV tool called “maintenance website”, on which all incidents and work orders, both preventive and corrective are recorded.

The system can thus give an instant monitoring report of all activities carried out. Preventive maintenance is based on routines to ensure early detection of any system faults plus a procedure to guarantee structural integrity.

Preventive maintenance tasks distinguish between the various system components, such as hardware and software. All operations/tasks have a one-year frequency taking into account such

premises as the following: whenever corrective action is carried out on any component, preventive maintenance will be carried out too; during any year at least 85% of hardware has to be checked; in each piece of equipment/installation (barring the control center), in default of maintenance, the inspection time cannot exceed one year and a half; control center maintenance will be perfectly coordinated and programmed with the client.

Corrective hardware and software maintenance is based on three levels with replacement of the hardware component and instant restoring of software images. Each hardware and software incident is assigned a Service Level Agreement (SLA) according to its criticality and is perfectly detailed in the maintenance plan. Thoroughgoing recording of all corrective action from the maintenance website will keep a constant track of project compliance and state.



GMV forges even stronger bonds with Auvasa



■ GMV's relationship with AUVASA now dates back over 20 years. One of GMV's first and most important contracts after setting up business in Valladolid was to establish the GPS-based transport control system for Valladolid's bus company (AUVASA).

AUVASA has recently reaffirmed this trust in GMV by awarding it a further contract for renewal of its buses' onboard fleet management equipment and bus-stop information panels, both currently made up by equipment and electronic boards that are now about 20 years old.

The new onboard tracking equipment is the **REC30** model with 3.5G technology for real time transmission of GPS tracking information; it can also double up as a surveillance video, backed up by three Power-over-Ethernet (PoE) digital cameras. Other new features are voice communications with the control center by Private Mobile Radio (PMR), emergency system and

connection with the electronic fare collection system for data download and control.

One particularly noteworthy new feature in 6 vehicles of the fleet is replacement of their inside LED panel by a multimedia information system based on a TFT screen, informing passengers of the next stop, terminal station and useful travel messages. There is also the possibility of inserting images or videos of interest to passengers.

The bus-stop information panels have switched from PMR to a more modern 3.5G technology, together with a facelift and improvement of visibility using LED type electronics and new methacrylate panels.

AUVASA is also bringing in new features to give real-time bus-stop information to visually impaired passengers, who are issued with handhelds to activate loudspeaker announcements from these new panels.

GMV presents its Intelligent Transportation Solutions at the "Congresso Rodoviário Português"

From 28 to 30 May Lisbon hosted the ninth transport-infrastructure congress called "Congresso Rodoviário Português", held this year under the banner theme "The Importance of Good Practices".

The event's guest country this year was Brazil, among other representatives of Portuguese-speaking countries.

As well as running a stand in the exhibition area GMV also presented two papers, one on the integrated transport management system successfully set up in Braganza and another on demand-response systems as the flexible answer to the mobility problems of low-population areas.

Organized by the Portuguese Road-Transport Center (*Centro Rodoviário Português: CRP*), the congress served as a meeting point for managers, technicians, teachers, researchers and other transport-infrastructure stakeholders, affording the ideal stage for swapping notes and establishing the synergies needed to meet the sector's latest challenges.



Castilla y León entrusts GMV with its demand-response transport up to 2020

■ The Regional Environment and Public Works Ministry of Castilla y León has decided to prolong the contract first awarded to GMV in 2004 for management and maintenance of the Castilla y León demand-response transport system up to September 2020.

For some years now population levels have been falling in country areas. This makes it hard to offer a top-quality transport service, and local residents therefore have mobility problems even for receiving basic services like healthcare. To stem the population drain away from these country areas the Regional Environment and Public Works Ministry of Castilla y León (*Consejería de Fomento y Medio Ambiente de Castilla y León*) came to the conclusion

that the only way of providing a service for these low-population areas, where scheduled services are no longer profitable, was a demand-response solution.

By now this service has become a byword for a comfortable, safe journey for most residents of Castilla y León. By a simple phone call any resident can now make that journey to the local health center or any other site he or she may need to visit. This represents a real increase in quality of life for country dwellers, many of whom are elderly persons without any other means of transport.

The Regional Authority of Castilla y León organizes the region into various

zones, then defining the routes and timetable to suit user needs in each one. Users then request the service with a simple, free phone call to the booking center located in GMV's Boecillo office, which then arranges the bus service accordingly. These bookings are then passed onto the transport operators by three different vectors: cellphone text message, onboard message console or the demand-response website.

Castilla y León's demand-response is an original, trailblazing system in Europe. It is currently providing a service for nearly one million people and over 3000 localities and will now run for another 15 months from 1 July 2019 to 30 September 2020.

GMV takes part in UITP's biennial summit, this year in Stockholm

■ From 9 to 12 June Stockholm hosted the latest Global Public Transport Summit. Organized by the International Association of Public Transport (UITP), the Global Public Transport Summit is the world's biggest event dedicated to the sustainable mobility of urban and regional transport.

The 64th edition of the UITP Global Summit hosted 474 exhibitors from 46 countries and 2,718 attendees. This allowed for an enriching exchange of ideas and innovative approaches to the growing mobility challenges across the globe.

Under the banner theme "The Art of Public Transport", the remit of the 2019 Global Public Transport Summit was to encourage the use of public transport and all the knock-on advantages this entails. The summit argued that public transport should be defined by cities' real needs and designed by forward-looking experts.

All this sector's stakeholders, it claimed, are visionaries, building connections and providing services to create a culture that brings people together.

GMV was present at this biennial event to showcase its whole range of solutions for the transport market. The company's stand staged meetings with clients and partners as well as demos of the different products in display such as the Fleet Management System, Ticket Vending Machines or the Planning & Scheduling System.

Carlos López Montero, Business Development Manager of GMV's ITS sector, was also at the summit to take part in a panel session titled "Connecting buses for smarter mobility" where he presented Deepspy, GMV's new software platform for the in-vehicle ITS ecosystem. This platform facilitates the development and integration of new software services provided by third parties,

increasing therefore the efficiency of the investments undertaken by public transport operators and authorities as well as providing them with a higher level of freedom from the suppliers.

GMV's participation in this biennial summit brings into full focus the company's leadership in the design, development, implementation and rollout of intelligent transportation systems (ITS) based on IoT, mobile communications and GNSS.



GMV performs follow-on contracts as part of the extension of Passenger Information Systems in Poland



■ Bydgoszcz is a city where electronic systems for public transport Fleet Management and Dynamic Passenger Information have been operating for years. The onboard computers with GPS locators that collect identification data from the vehicles as well as the stops on bus and tram routes, delivered by GMV, were installed in Bydgoszcz as early as 2012. The collected data makes it possible to provide the passengers with bus- and tram-stop ETAs, which Bydgoszcz inhabitants read on electronic panels. The data from the onboard computers, processed in the Fleet Management System, are also used by the dispatchers (who regulate the operation of the vehicles

in public transport), in order to improve punctuality in the whole transport system – which is beneficial for all users.

The Fleet Management and Passenger Information System in Bydgoszcz, delivered and maintained by GMV, is subject to continuous development. On the occasion of municipal road investments (thorough modernization or construction of new roads), the Dynamic Passenger Information System is gradually phased in to cover all the subsequent bus and tram stops. At the end of 2018 GMV concluded an agreement with the electrical works contractor, Inel, for the supply and installation of four LCD panels, and in April of this year, it concluded an agreement with the General Contractor, Budimex, for the supply and installation of a total of 14 new LCD panels incorporated into the PIS.

The situation is similar in other Polish cities where GMV's Fleet Management and Passenger Information Systems operate. In August GMV was awarded a contract by the Roads and Municipal

Transport Authority in Szczecin for the supply of three PIS panels in a new location in the city, including the installation and construction of power supply connections. Recently, GMV was awarded a contract by the Municipal Transport Authority in Gdańsk for the design and construction of a power supply connection, as well as for the supply, installation and start-up of one PIS panel operating within the TRISTAR system. The company also concluded an agreement for the supply of six PIS panels with Aldesa, which, as General Contractor, is implementing a tramline modernization project in Gdańsk.

Public- and private-sector employers with whom GMV cooperates repeatedly emphasize their appreciation of the high quality of the delivered products, the dependability and professional approach of the managerial staff supervising the performance of each contract. They therefore willingly choose GMV as a partner to carry out works within the scope of the extension of Passenger Information Systems.

The Fleet Management and Passenger Information System for Bydgoszcz and Szczecin, delivered and maintained by GMV, is subject to continuous development

GMV upgrades RENFE's local and medium-haul fleets

GMV takes on the first enlargement of the Onboard Communications System, now completely deployed on RENFE's local and medium-haul fleets



■ Spain's national railway network RENFE has awarded GMV the contract for a first functional enlargement of its Onboard Communications System, fitted on its local and medium-haul fleets.

The original Onboard Communications System was originally put out to tender by RENFE with the aim of setting up a unified fleet-management and communications system for the company's various vehicles. This initial project, in essence similar to a fleet-management/Automated Vehicle Location System (AVLS) system, was awarded to GMV and has now been rolled out on RENFE's whole local and medium-haul fleet.

With the growing use of the system RENFE has now asked for some upgrades. This first functional enlargement involves development of the platform's documentation system. At the moment this system allows

the driver to make offline enquiries of necessary service documentation (timetables, maximum speed charts, etc.), plus other types of documentation like descriptive technical instructions and operational instructions for each model of train.

This documentation is uploaded remotely in the control center, located in the datacenter of Delicias, by means of an intuitive graphic view. In each updating carried out in the control center the documentation is synchronized with the copy available on the train, ensuring the information is always bang up to date. Onboard the information is displayed by means of a specific document reader.

In line with the company's ongoing process-digitalization improvements, including documentation, RENFE now wishes to automate too this driver-document communication channel.

First and foremost the document upload will no longer be manual but will now be fed in from other document systems recently set up by RENFE; the upload will therefore now be automatic with the information being fed into only one of these systems.

Other improvements involve the phasing in of certain control records of transmission, download and reading, to be integrated with the records currently made of these data-originating systems.

Lastly, the reading view of onboard documents will be improved, giving it a more modern look and adding on certain use features considered to be of interest by RENFE.

All these upgrades show that RENFE is keen to renew and maintain this key system in its daily operation.



GMV spearheading the development of positioning technology for autonomous vehicles

GMV wins pole position as supplier of GNSS-based autonomous-car positioning systems, an area in which it now boasts a wealth of experience and a proven expertise



G MV announce the award of an important contract for development of a precise satellite-based (GNSS) positioning system with integrity for the new generation of autonomous vehicles of the German carmaker BMW Group.

Autonomous driving calls for technology and systems providing a positioning service with the maximum precision, safety and reliability. This is where GMV's inhouse autonomous-car solutions come into their own, based on global navigation satellite systems and drawing on the company's proven expertise and experience in the space sector.

GMV's technology solution is going to be developed for the first time in BMW Group's autonomous vehicles. This positioning software calculates the vehicle's position and other magnitudes,

using advanced GMV-developed algorithms, including components that have already been patented. These algorithms have been especially modified and adapted to meet BMW Group's performance and safety requirements.

Not only that, but the developed software will abide by the most demanding automotive standards and the highest quality levels of safety-critical software.

Another of the key components provided by GMV is a GNSS correction service to be run in a secure infrastructure using data from a global network of monitoring stations to be set up by GMV under this contract.

This new project cements GMV's position as a supplier of autonomous-car positioning solutions based on global navigation satellite systems.

«GMV has been investing for many years in the key GNSS technologies that are essential for autonomous driving systems. For our company this contract represents a unique opportunity to capitalize on all that effort, providing a product of outstanding performance for the automotive industry»

Miguel Ángel Martínez Olagüe
GMV's General Manager of
Intelligent Transportation
Systems

GMV once more collaborates with ASEPA in its latest autonomous-vehicle course

■ Late June saw completion of the fourth Autonomous and Connected Vehicle Course (*Curso de Especialización en Vehículo Autónomo y Conectado*), organized by the Spanish Automotive Professionals' Association (*Asociación Española de Profesionales de Automoción: ASEPA*) in collaboration with the University Institute for Automobile Research (*Instituto Universitario de Investigación del Automóvil: INSIA-UPM*).

The 50-hour course is divided into two modules: one dealing with the autonomous vehicle and the other with the connected vehicle. The former takes in both hardware and software aspects and involves practice runs on test tracks. The latter delves into the connected vehicle's technical aspects, taking in not only communication systems, but also applications, services and cooperative systems, again with test runs.

The course was given by 13 experts in these future specialties, including researchers, academics,



representatives of the main firms and the most advanced brands in this field of autonomous and connected vehicles. In the words of ASEPA itself, it was possible to hold the course again thanks to "the excellent reception" of the three previous occasions.

Sara Gutiérrez, manager of GMV's automotive business unit, collaborated once more in the course, taking one

of the sessions. This session dealt with different vehicle-to-vehicle communication application cases, giving details of a wide range of connected-vehicle services where GMV is inputting its wealth of experience.

The qualification for completing the course will be the academic certification of the *Instituto Universitario de Investigación del Automóvil* (INSIA-UPM).

GMV showcases its advances in the car city par excellence



GMV was present at the latest TU-Automotive conference, held from 4 to 6 June in Detroit (Michigan, USA).

A showcase of the latest connected-vehicle and autonomous-vehicle technology, TU-Automotive this year displayed the latest breakthroughs now being achieved in areas such as connectivity, positioning, integrity and security.

The event brought together top professionals and technicians from the automotive area, showcasing connected car technology, intelligent mobility, the electric vehicle and the latest breakthroughs in autonomous driving technology. Both carmakers and providers of hardware and software components

and services were able to swap notes on the latest advances in this technology.

GMV ran a stand showcasing its range of inhouse, R&D-driven solutions for this sector, including: hardware/software platforms for the connected vehicle, precise GNSS positioning systems, intelligent connectivity modules and critical software, plus Cybersecurity services for the connected and autonomous vehicle.

GMV also took part in a discussion panel to talk about the latest breakthroughs in precise and safe technology as applied to the autonomous car, where GMV's wealth of experience has made it leader in the GNSS sector (Global Navigation Satellite System).

Autonomous driving is coming closer



■ On May 21 and 22 the SafeCOP project partners met up in Trondheim, Norway to present the final results of the work performed during the past 3 years.

The meeting was organized by GMV partners, Maritime Robotics and SINTEF and the agenda was composed of several presentations from the project coordinators, work package leaders and use case leaders and also one live demonstrator from the maritime use case.

The consortium, comprising 27 European partners, from academia to industry, has collaborated in 5 industry-driven use cases to improve the safety and security of automated systems in 3 domains (automotive, maritime and health).

As work package leader and use case leader, GMV had an active participation in the event, presenting use case 3 results and the whole project requirements coverage and traceability.

Under the scope of SafeCOP, GMV has collaborated with ISEP in the definition and implementation of a distributed control loss warning (CLW) function for autonomous vehicles. In this particular use case, the function selected was vehicular platooning.

The idea behind the CLW is to detect abnormal behavior from the vehicle or neighboring vehicles and have the auto pilot act accordingly in order to avoid accidents.

The use case was evaluated by comparing the results of running the platooning function with and without the SafeCOP elements. The key results obtained were the ability to decrease from 13% crashes to 0% and a relevant decrease in the response time taken to act upon a warning from 30 milliseconds to just 4.

The final solution makes use of ISEPs fault tolerant runtime monitor and GMVs V2X communication stack and CLW function.

The automotive industry is moving fast into the automation arena. This poses new safety and security threats that need to be dealt with before such technologies are brought to market. With this challenge in mind, GMV embarked on this 3-year voyage through the world of automation along with its 26 partners, creating along the way the knowledge and tools necessary to make autonomous driving a reality in the coming future.

Under the scope of SafeCOP, GMV has collaborated with ISEP in the definition and implementation of a distributed control loss warning (CLW) function for autonomous vehicles

ESCAPE takes on the third test campaign



■ In the last week of June the labs of Université de Technologie de Compiègne (UTC) in France hosted the third integration test campaign of the ESCAPE project (European Safety Critical Applications Positioning Engine).

ESCAPE, funded by the European GNSS Agency (GSA), aims to exploit the services offered by Galileo, Europe's satellite-navigation system, for the purposes of autonomous driving. Led by the Spanish company FICOSA, ESCAPE brings together some of Europe's top industrial and research institutions to create a positioning engine for automotive safety-critical applications, i.e., applications involved in highly automated driving.

GMV is playing an important technical role in the ESCAPE project. It not only holds responsibility for technical project management but also, as part of the development of the ESCAPE GNSS Engine (EGE), GMV will be supplying the algorithms to process the readings of the vehicle

sensors, the cameras and GNSS receiver, in order to provide the positioning service together with the integrity required by the connected autonomous vehicle. It will also be providing the intermediate data-fusion layer software, in charge of binding all the communication components together into a synchronized, well-oiled system.

During this integration week the teams of FICOSA, GMV and Renault put their heads together with UTC scientists to conduct a new and comprehensive series of tests on the closed circuits both on UTC's site and on the public thoroughfares of Compiègne. After the campaign all recorded data will be processed by the various teams to assess system performance and thus identify any room for improvement.

Both this year's campaign and the earlier July and October 2018 campaigns are crucial in the development and upgrading of the project, exposing the prototype EGE

to diverse real operating conditions, including static and dynamic vehicle, open sky, suburban and urban scenarios.

The project is now entering the final straight, involving an evaluation of the performance of the most advanced GNSS receiver. For that purpose the receiver will be put through its paces in the Ispra Joint Research Center in Italy before finally bringing all the results to wider notice.

ESCAPE, funded by the European GNSS Agency (GSA), aims to exploit the services offered by Galileo

GMV contributes to the definition of skills and tools for validation of safe automatic systems

■ On 16 and 17 May the participants of the ENABLE-S3 project (European Initiative to Enable Validation for Highly Automated Safe and Secure Systems) presented the most important results of three years of busy research under this European Commission Horizon-2020-funded project in the framework of the ECSEL Joint Undertaking.

The consortium that developed the project, made up of 68 European OEMs,

suppliers, tool providers, as well as research institutions, has collaborated in industry-driven use cases to improve the safety and security of automated systems in six domains (automotive, aerospace, rail, maritime, health, farming).

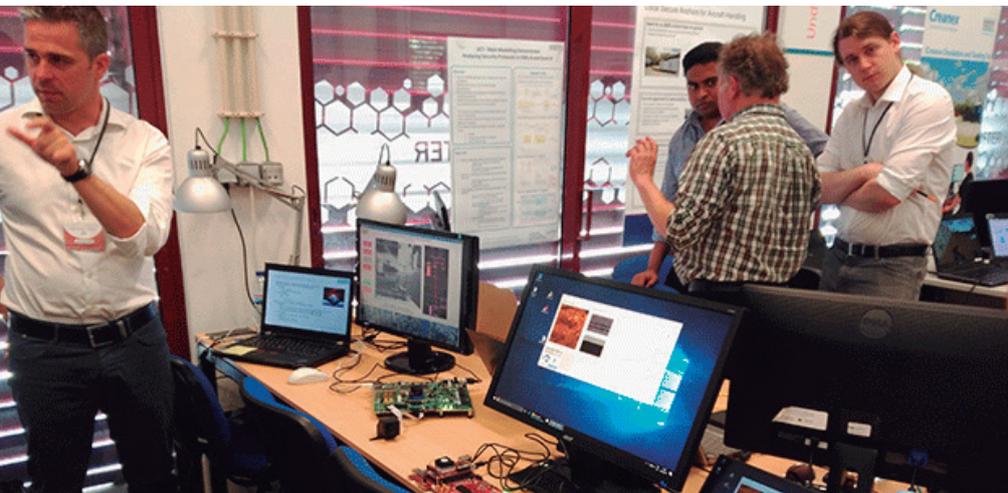
This event, which took place in Graz (Austria) brought together industry stakeholders, funding authorities, politicians and other European projects and gave first-hand insights into one

of the biggest EU-projects about V&V testing for automated systems.

GMV duly attended the event as project participant and presented the results of the cases carried out during these three years in the two use cases it is leading, one focusing on the automotive area and other on space.

In these past three years, ENABLE-S3 has established the required skills and tools for the validation of automated systems in Europe. The technology resulting from this work supports the market introduction of automated systems by enabling safe, secure and functional systems across six domains; establishing a modular comprehensive testing and validation framework for scenario-based testing; and driving open standards for higher interoperability.

Visitors had the exclusive opportunity to gain first hand insights into demonstrators from across six domains and meet the people driving this project.



GMV holds the kick-off meeting of the C-STREETS mobility project

■ From 3 to 6 June The Netherlands hosted this year's ITS Europe event, bringing together a large part of the European ITS community to exchange ideas, discuss business and showcase innovative solutions.

MaaS is now the ITS buzzword. This 4-day event clearly brought out the enormous public interest in MaaS and all associated solutions. From *Big Data* to seamless mobility, from electrification to public transport, the greatest enemy nowadays is the private vehicle. While there is still room for it, the private vehicle is about to become less private and more sharable.

Mobility is not just about getting to a destination, but rather about the way to get there. Disruption has arrived in the mobility sector and only organizations able to play the mobility game will understand that mobility is not just transportation.

Mobility is the freedom to choose when and how and with whom, anytime, anywhere. It's about enabling access to everyone regardless of whether you're blind, deaf or move in a wheelchair; mobility is for all.

For GMV and the whole Portuguese consortium, the June 6 was particularly special, as this was the day that the

C-STREETS Grant Agreement was signed between CEF Connecting Europe Facility) and the president of IMT (*Instituto da Mobilidade e Transportes*), Eduardo Feio, on behalf of the Ministry of Planning and Infrastructure.

Thirty national partners were awarded a €32-million contract to further deploy C-ITS services in Portuguese urban areas.

C-STREETS is the current continuation of the original C-ROADS Portugal project where GMV started the C-ITS journey back in 2017, now extending it until the end of 2023.

Open Data as the base of new services and other benefits for citizens

Reuse of public-sector data is becoming an increasingly important factor in government strategies. European institutions are giving a clear push to data reuse policies as a driving force of the digital economy and a mainstay of democratic transparency. In Spain there has been a surge of private and public initiatives in recent years, all seeking to obtain the maximum benefit from public-sector information and its reuse. The idea behind this endeavor is to bring in improvements in factors as diverse and important as transparency, citizen participation, innovation, economic growth, job generation, social benefits and aid in decision making.

Spanish government authorities have shown their readiness to push open government, based on three pillars: transparency, citizen participation and open data. As pointed out in the GMV-developed portal datos.gob.es, there are now 293 initiatives underway, 42 of them at central-government level, 17 at regional level, 225 in local authorities and 9 in universities. Indeed, Spain is one of Europe's most open-data-friendly countries behind only Ireland, according to a recent report by the European Data Portal. This same report claims that open data will save the public sector 1.7 billion euros by 2020. It will also enhance the performance

and efficiency of public services, such as the detection of unnecessary spending or the overlapping of information from different sectors.

The fundamental aspects to be taken onboard by any government in carrying out an open data project are the drawing up of a strategic plan and the assigning of project leadership. The aim of these initiatives is to bring out the value of available data, after due evaluation of its validity and truthfulness. The data held by government authorities is particularly valuable, especially if made properly available to companies and users.

In light of initiatives of this type there are three main challenges to be taken onboard here: firstly, cultural change; secondly, bringing government data into line with established formats for then being opened up; and, thirdly, Cybersecurity. Identifying the data to be opened up and doing so on the basis of standards affording across-the-board access in a unified way is crucial. Open data is public, but, depending on the architecture used to open up this data, Cybersecurity may or may not be enough to protect the integrity of these systems and keep them properly controlled and managed.

We at GMV are working on one of Europe's biggest open data projects, Copernicus, where we are providing



Patricia Tejado, Digital Public Service Manager of GMV's Secure e-Solutions sector

«European institutions are giving a clear push to data reuse policies as a driving force of the digital economy and a mainstay of democratic transparency»

infrastructure Cybersecurity and platforms to facilitate use of the information for offering new services. This initiative offers key data for setting up user services and wins GMV a recognized position as technology partner of those governments that are setting up open-government projects.

New models and technologies for speeding up processes and digitalizing the chemical and plastics industry

■ The ongoing development of industry has been inevitably tied in with technology for some years now, technology designed to improve results, bring in new business models and introduce new future-making trends.

We are living through dizzying, dynamic, constantly transforming times in which flexible, modular and versatile production techniques come together with human experience and automation, as well as cyber systems and groundbreaking technologies to replace static, sequential production systems.

With these ideas in mind, Miguel Hormigo, Industry Manager of GMV's Secure e-Solutions sector, tailored his intervention at ChemPlast Expo, held from 5 to 7 May, to give a brief account of the impact of the first industrial revolution and its similarities with what we have come to call Industry 4.0.

His speech in this industrial tradefair, which brings together the most trailblazing solutions in materials, technologies, processes and machinery for the chemical and plastics industry, focused on the convergence, personalization and technology that have been fundamental in carrying through this new digital transformation. Looking to the future, he dwelt on figures like the number of worldwide IoT connections, which are expected to soar from 14.87 billion in 2016 to 36.13 billion by 2021. He also cited collaborative robot sales, which are expected to increase from 58,000 in



2018 to an estimated 150,000 by 2020. Hormigo also talked about technological automation, digitalization and Cybersecurity projects now underway in industrial processes, where, it should not be forgotten, the human factor will always be crucial to success. He likewise quoted **VirtualPAC**, a groundbreaking solution capable of virtualizing control processes deployed in a Programmable Logic Controller (PLC) so that these can be dynamically changed, deployed and operated remotely to improve processes or solve any defects, all without needing to shut down plant maintenance.

Hormigo's cue was taken up by Ángel C. Lázaro, Industry Business Partner of GMV's Secure e-Solutions sector, who set out some examples of production improvement and streamlining projects

linked to Lean 4.0. This management model allows groundbreaking and disruptive uses of technology to favor more efficient industry with a built-in flexibility to suit real market needs. A good example is the use of artificial intelligence together with Big Data and cloud infrastructure to harness data from various sources and thus achieve a predictive, demand-adjusted and stock-trimming production process.

This year's ChemPlast Expo announced the winners of the second ChemPlast Awards. Dow Chemical Ibérica received the "GMV Prize for the best business initiative to tackle the revolution 4.0 challenge in industry", in recognition of its initiative of integrating the human factor into its project, saving human lives and contributing towards worker security.

GMV at #VLCSofting19

In June the IT Technology Institute (*Instituto Tecnológico Informático*) put on the fifth #VLCSofting, an event that has become a must within the national panorama to keep in touch with the

latest software technology and trends.

Under the banner theme "What sort of company do you want to be?" the event

organizers set out to encourage not only companies' use of technology as a business opportunity but also to integrate it into the whole value chain. As in previous years GMV supported and participated in the event.



Artificial intelligence and digital twinning, the perfect match for Industry 4.0

■ On 30 May Madrid hosted the 2nd Artificial Intelligence Encounter organized by the Spanish Association of electronic, information-technology, telecommunications and digital-content firms (*Asociación de Empresas de Electrónica, Tecnologías de la Información, Telecomunicaciones y Contenidos Digitales*: AMETIC).

Pedro Mier, AMETIC president, gave the opening address, holding up artificial intelligence as the great transformation lever for reindustrialization of new businesses, thus opening up a huge range of possibilities for boosting our companies' productivity and competitiveness. Taking his cue from these opening words, Spain's Minister of Science, Innovation and Universities, Pedro Duque, argued that artificial intelligence is one of the disciplines destined to change Spain's production model the most and will

help to make Spain more resilient to the rollercoaster ride of the world economy. Nonetheless, the minister then added that we cannot lose sight of the ethics of its use and the quality of the jobs created.

The encounter also presented practical cases showing the development of artificial intelligence in diverse sectors. The Artificial Intelligence and Big Data Manager of GMV's Secure e-Solutions sector, José Carlos Baquero, presented an example of how artificial intelligence could be brought to bear on the optimization of production processes: "Digital twinning and artificial intelligence: a perfect match for Industry 4.0". During his intervention he gave a demo with a virtual representation of the workings of a thermosolar plant with the objective of simulating its operation and acting on the corresponding operational variables

to achieve the greatest possible efficiency in electricity generation, showing that digital twinning can help to turn artificial intelligence solutions to the best account.

In industry the main use of artificial intelligence is to help monitor, optimize and control the behavior of its operations and systems to improve efficiency and boost performance. With the additional help of digital twinning it becomes possible to simulate fault modes for predictive maintenance, create new operation policies, conduct in-plant experiments at lower risk and automate and control industrial processes. In-plant changes always imply a certain amount of risk and are difficult to bring in; digital twinning, however, makes it feasible to use simulation-based models or models obtained from data.



New version of IDEAS, the patent-management software solution

■ In late June GMV took part in the RedOTRI Conference to present the upgraded functions of the software solution for the management of intellectual property, IDEAS.

IDEAS was born in response to the *Universidad Autónoma de Barcelona's* need of protecting its researcher's industrial property in a swift, secure and simple way. This application manages all types of industrial property (Patents, Technological Bid, Copyright, Agreements, Trademarks, TBCs, Projects, Knowhow, etc.) offering the information in a detailed way: state, key dates and deadlines, legal documentation and information and the patent's complete genealogical tree. In another words the application accompanies the researcher



on the whole journey from the seminal idea to the final consolidation as a technological and commercial bid.

IDEAS has now been taken up by universities like *Universitat Rovira i*

Virgili, Universidad de Alicante and the *Universidad Autónoma de Barcelona* itself plus institutes like the *Instituto Nacional de Técnica Aeroespacial (INTA)* and the *Institut Català d'Investigació Química (ICIQ)*.

How to achieve unbiased algorithms. The importance of ethics in Artificial Intelligence



Artificial Intelligence is making increasing inroads into our daily lives, to the huge benefit of one and all. Nonetheless, decision-making in machine-learning algorithms can recreate and perpetuate harmful historical biases. The growing takeup of this technology has racked up social concern about the transparency and fairness of machine learning.

José Carlos Baquero, Artificial Intelligence and Big Data Manager

of GMV's Secure e-Solutions sector, stressed the importance of artificial intelligence ethics during his paper at the I Aragón Summit 2019 (Zaragoza, 23-24 May), explaining how to get bias-free and even-handed algorithms.

There is obviously no going back on the introduction of Artificial Intelligence and machine learning but we do need to set ethical limits that serve as some sort of restraint. Worries about the loss of transparency,

responsibility and fairness of decision-making algorithms are on the rise; hence the growing need for reliable ways to head off any discrimination in our models. Baquero's speech ran through some of the approaches to the challenge of achieving fair predictive models, including interrogation of complex models, focusing on interpretability and transparency, or modifying the optimization of the target functions and adding constraints in order to achieve more robust and fairer predictive models.

For example, amending any discriminatory bias in algorithms is impossible if these algorithms are opaque. In this case transparency is a sine qua non. A solution could come from monitoring and divulging where Artificial Intelligence systems are used and for what purpose. In any contracting process, understanding the points where algorithms may come into play could help to pinpoint the origins of the bias.



Creation of an ecosystem for driving quantum technology

■ Quantum technology looks set to be one of the main pillars of the next scientific and technological revolution, due to occur in the next few years. It will be an emerging market of great complexity and immaturity, where proper knowledge and advice will therefore be paramount in harnessing the new developments as they occur over the upcoming years. All companies from all industrial sectors that want and need to keep in close touch with these technologies will have to define their strategic plans on pain of missing out on this new computational revolution or falling behind and forfeiting market competitiveness against companies that have forged further ahead.

On 14 May the Spanish Association of Electronics, Digital Contents and ICT Companies (*Asociación de Empresas de Electrónica, Tecnologías de la Información, Telecomunicaciones y Contenidos Digitales*: AMETIC), in collaboration with the Spanish Science and Technology Federation (*Fundación Española para la Ciencia y la Tecnología*:

FECYT) put on a conference to present the “Quantum Spain” report. This report gives an overview of Spain’s quantum technology ecosystem, focusing on the application of socially and economically impactful technological solutions in various key sectors of Spain’s economy.

The report was presented by Luis Fernando Álvarez-Gascón, General Manager of GMV’s Secure e-Solutions sector and President of AMETIC’s Innovation Committee, together with Ulises Arranz Cuéllar, Head of the quantum area of ACCENTURE, and Alfonso Rubio-Manzanares, President of Barcelonaqbit and Coordinator of AMETIC’s Quantum Technology Group. Álvarez-Gascón talked about the importance of winning Spain a more influential position in cutting-edge technology like quantum technology, where Europe and Spain have both fallen behind the pace-making countries like USA and China.

The various speeches dealt with such aspects as communication, simulation, cryptography and quantum

computation as the most promising features within this field. Another strong argument was that quantum technology should be given more prominence in the country’s new R&D strategy. The experts highlighted the need of building up a “Quantum Spain” and joining in the 3rd Quantum Revolution, stressing too the importance of the human factor in this endeavor. This sterling challenge involves bringing the supply- and demand-sides together to generate an ecosystem capable of carrying out innovating activity in Spain.

Álvarez-Gascón talked about the importance of winning Spain a more influential position in cutting-edge technology like quantum technology, where Europe and Spain have both fallen behind the pace-making countries like USA and China



Science, technology and innovation in Menéndez Pelayo

■ On 11 and 12 July the *Universidad Internacional Menéndez Pelayo* (UIMP) put on in Santander a summer course on Spanish Science, Technology and Innovation Strategy 2021-2027. Luis Fernando Álvarez-Gascón, General Manager of GMV's Secure e-Solutions sector, as president of the Innovating Companies Forum (*Foro de Empresas Innovadoras*: FEI), took part in the discussion panel "Science and innovation

as an economic and social driving force".

During the inauguration of the course the Secretary of State of Universities, Research, Development and Innovation, Ángeles Heras, ran through the main lines of the Spanish R&D Strategy 2021-2027. As "main thrusts" she highlighted the bringing of this strategy into line with the United Nations' sustainable development goals;

its coordination with artificial intelligence; "sustainable blue-economy innovation", which has been defined as the study of the seas as renewable energy sources; energy and climate and biomedicine research.

This initiative offers an opportunity to find out about advances in strategy definition that will be crucial for the future of science, technology and innovation in Spain.

Sustainable innovation as a challenge for Ibero-American companies

Top experts and businesspersons came together in the 8th Business Forum: Innovation & Sustainability", held on 30 May and set up by the Regional Center of the Private Sector (*Centro Regional del Sector Privado*: CR/SP). Its overall aim was to take stock of the current state of development and sustainability in the Ibero-American region.

For each forum the Regional Center identifies a key issue for the private sector and works with the host

country's top professionals to hold the event. The keynote theme of this year's forum was Innovation and Sustainability as central thrusts for business adaptation and development.

Other issues dealt with were Agenda 2030 as a tool in business decision-making, the rule of law, investment security and sustainable innovation as the great challenge for Ibero-American companies. This last panel was chaired by Luis Fernando Álvarez-Gascón, General Manager

of GMV's Secure e-Solutions sector and President of the Innovation Committee of The Spanish Association of Electronics, Digital Contents and ICT Companies (*Asociación de Empresas de Electrónica, Tecnologías de la Información, Telecomunicaciones y Contenidos Digitales*: AMETIC).

This forum acts as a sustainability- and innovation-debating platform, presents the latest trends and looks at the practical use of UN initiatives by the private sector.





DevOps, a natural path towards security

DevOps has historically been understood as the sum of a collaborative business culture, tools and processes designed to close the breach between development and operation teams. The level of compliance with this working philosophy has now become a touchstone of the degree of maturity of any organization's software development processes. Long gone now are the days when developing robust and scalable functional code was a reliable sign of doing things well.

The time to market imposed by a fiercely competitive market jeopardizes the quality of the developed code and, ipso facto, the success or otherwise of projects. Profound changes in the working methodology of development and operations teams and powerful new technologies made it possible to speed up code deliveries without forfeiting quality. In the interests of this compatibility between speed and quality companies took to heart the principles of the agile manifesto and focused on automation of all code-testing and construction phases (continuous integration). Processes were improved so that each change could pass through an automated testing and deployment process in the various environments (continuous delivery) or even be deployed automatically in productive environments (continuous deployment). Agile development, potent software ecosystems of continuous deployment and integration and technologies like

Dockers all helped to speed up development cycles and delivery times as never before. In short, the DevOps outlook has helped to make us all speedier but this very agility makes us more vulnerable to new threats and risks.

The worst-case production-system scenario would be continuous exploitation of code level vulnerabilities by cyber criminals, but DevOps once more marks out the path to follow through its natural sequel: SecDevOps. Historically, security checks have been conducted in the code deployment phase by Cybersecurity specialists. This working philosophy is incompatible with the necessary agility because detected security problems force a backward step to earlier development cycle phases. Moreover, this work organization method distances developers from the secure development culture. Once more we find ourselves up against an unnecessary breach between teams, in this case between developers and Cybersecurity specialists. The solution to the problem is the same: team integration, automation and well defined processes.

The only realistic option is to incorporate security into the initial project phases, focusing on the Security by Design approach. Right from the initial capture of requirements it is essential to model threats under the paradigm of recommendations and regulations like PCI, OWASP and GDPR. This threat modeling will be carried out by a



Miguel Recio González, Manager of the Software Development Division of GMV's Secure e-Solutions sector

«Long gone now are the days when developing robust and scalable functional code was a reliable sign of doing things well»

team that will not be an isolated department watching out only for already completed developments but will rather form part of the whole project lifecycle.

Integration between development and Cybersecurity teams will guarantee compliance with all actions defined in the threat modeling, raising the awareness of the whole team and reducing delays due to late detection of vulnerabilities. Automation of configuration processes and checks in the continuous deployment and integration phases will be added values guaranteeing that DevOps, far from posing a threat to security, will be the best solution.



Driving digital talent, looking to the future



The technology sector is one that stands to lose most from the shortage of talent. The European Commission has forecast that the demand-supply gap in the ICT job market will add up to 500,000 by 2020 due to this chronic skills shortage.

Mindful of the scale of this problem, AMETIC, Spain's digital employers' association, put on in June the 2nd Forum for the Development of Digital Talent in Spain (II Foro Alianza por el Desarrollo de Talento Digital en España), with the aim of bringing to wider notice the new skills sought by ICT organizations and other sectors immersed in their digitalization process.

The forum brought together sector high-ups, businesspersons, politicians and government officials, as well as companies, business schools and universities.

As in the first forum, GMV supported AMETIC's initiative, and Crescencio Lucas, Managed Services Division Head of GMV's Secure e-Solutions sector took part in the panel discussion "The present and future of professional skills".

GMV is a technology company that bases its success on the talent of its 2000 professionals. This talent is the sum of two concepts, the first relating to how much the person knows, i.e., what he or she knows how to do professionally, what training he or she has, and the second to "the adaptation capacity", understood as the will and keenness to learn, flexibility, motivation and a huge passion for technology.

The importance of AI ethics in processing visual information

■ From the artificial intelligence point of view, vision and image-recognition APIs are now mature enough for migration to advanced manufacturing and artificial vision processes. We can now safely talk about the performance of such tasks as detection of complex faults, classification of textures and materials, reading of characters, verification of assemblies, identification of misshapen parts, etc. The truth is that image-analysis software now offers real-time solutions for complex vision challenges.

Image recognition procedures allow us to interpret what system vision records and then classify and use it to optimize our industrial production chain or to meet other needs, in any other activity sector, that could not be carried out beforehand with traditional vision.

Image recognition works by creating a neural network that processes all image pixels individually before going on to process them as a whole. This technology, like all artificial intelligence, calls for instruction or training to improve the functions offered and model precision. For that reason

these networks are normally fed with as many images as possible.

The Artificial Intelligence and Big Data Division of GMV's Secure e-Solutions sector has developed a demo for OpenExpo Europe (Madrid, 20 June), Europe's biggest B2B technological innovation congress, showing just what artificial intelligence is capable of on the strength of image processing.

Artificial intelligence is giving rise to new tools and spectacular applications, outperforming humans in classification and image-detection tasks. But it is important to take the algorithmic bias into account. The algorithms used, after all, might make decisions that perpetuate past discriminatory attitudes in society or even generate new ones. This was precisely the issue dealt with by José Carlos Baquero, Artificial Intelligence and Big Data Manager of GMV's Secure e-Solutions sector, in his congress paper. Baquero's speech advocated transparency and clear explanation of training models in the search for fair algorithms and a responsible use of artificial intelligence.



35 YEARS WEARING GMV's COLORS

- 1. France
- 2. Holland
- 3. Romania
- 4. Germany
- 5. Portugal
- 6. United Kingdom
- 7. USA.
- 8. Poland
- 9. Spain



GMV celebrates its 35th anniversary



■ 2019 is a red-letter year for GMV. We chalk up 35 years since the start of the company's activity. This makes it the ideal time to look back, take stock and think about the future, hailing the effort, dedication and involvement of GMV's whole team, who have made it possible for GMV to become today's international business group trading in all five continents.

Our entire 2000-strong staff were therefore invited to one or other of the eight celebrations organized under the banner theme "35 years wearing GMV's colors" in GMV's various worldwide offices: Spain, Romania, Poland, United States, Germany, Portugal and the United Kingdom.

The first of these events was held on 31 May in Madrid, Spain. The turnout came mainly from GMV's offices in Barcelona, Valladolid, Valencia, Seville, Zaragoza and Madrid. The day kicked off with a group activity involving 1.000 people trying to form a "human logo". The event then carried on with music, food, chat and cheers, on a day when many of the colleagues from GMV's Spanish offices took the chance to get to know each other and mingle for the first time.

The celebrations then continued throughout the month of June, with events held in Bucharest (Romania), Warsaw (Poland), Los Angeles (USA), Toulouse (France)

More than 1.000 employees helped to create a "human logo" in an event that brought together all GMV's staff working in Spain

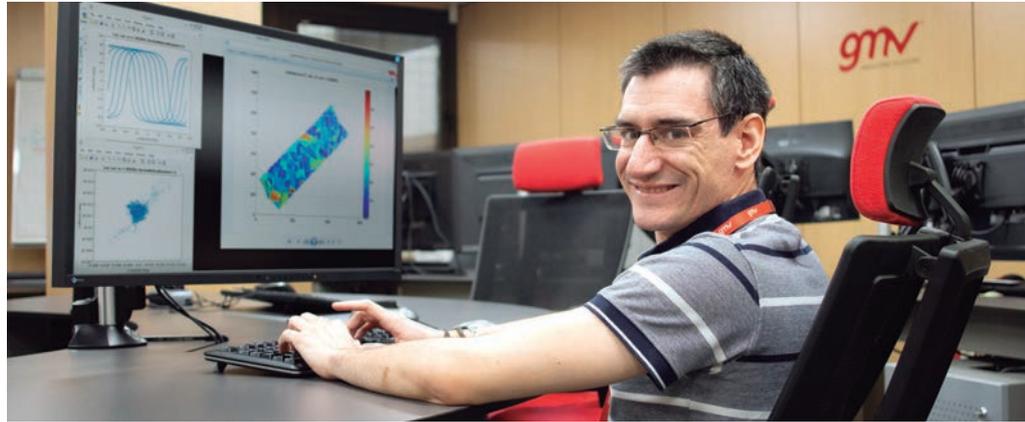
and Munich (Germany), involving activities like corporate art painting, collaborative cooking workshops and quizzes, among others. In the first week of July events were then held in Lisbon (Portugal) and Oxfordshire (UK), in which GMV employees enjoyed activities sharing a common denominator with all the aforementioned ones: to celebrate GMV's 35th anniversary and chill out with their work colleagues.

Daniel Toledano Sánchez

"My integration in GMV is complete"

I began working for GMV in September 2009. Just looking at this date written down gives me goose pimples. How the time flies by! The longest-serving veterans working in GMV's Tres Cantos head office will have passed me in the corridors more than once. Some possibly even remember me joining GMV. The newest members of the fold, growing by the day, maybe haven't even seen me yet. Mind you, if you have, you'll undoubtedly have noticed my own idiosyncratic gait. Veterans or otherwise.

But before speaking about the "me" of today, I'd like to sketch in the past, explain why I joined GMV in the first place, and, more or less, what has happened to me since. If I had to identify the moment when my mind first turned to space, this would be my time as a high school student, aged 16 or 18. By then, for some reason I still can't explain, all space-related physics problems fascinated me. I perfectly remember those problems they set asking you to calculate the escape velocity. The escape velocity! Many aeronautical engineers will be smirking right now. But for me the challenge started right there. And the fact is that I ended up asking my physics teacher what I needed to study at university to learn about satellites. And her answer was forthright: *Teleco*. By now I reckon I will have conjured forth the second smirk from some of you. Especially from those aeronautical engineers. Yeah I know, me neither . . . But, in default of any better advice, I did end up studying *Teleco*. So, anyway, to cut a long story short, back in 2009, I graduated from the *Universidad Politécnica de Madrid* as an *Ingeniero Superior de Telecomunicación* (higher telecommunication engineer), because that was the name the title went



under back then. Upon graduating, I was still determined to apply my learning to the space sector, and GMV came across as a fine option in Madrid. I sent in my *résumé*, got interviewed and joined GMV. This time I got it right: plunging head first straight into the space sector.

Since then I've continued to develop as a person and career wise too: I've worked as project engineer in earth observation missions, in remote sensing, in mission analysis, in end-to-end simulators developing instrument algorithms of varied ilk, etc. I currently working as a head of project and run my team and myself as best I know how.

But what I'm most thrilled to share with you all is this: in GMV the work might turn out to be more or less interesting, more or less frenetic. And this not only depends on the particular job at each moment but also varies wildly from project to project. I'm convinced that here the human content is of the highest quality. And I'm not referring only to the expertise and supreme skills of the workers. GMV is full of good people. And all this goodness naturally pans out as the various actions we are now implementing within GMV's equality

plan, tackling such aspects as cultural integration, disability, diversity, inclusion or workplace integration within GMV. But I've been grateful to GMV people from practically my first working day. From way before the aforementioned GMV initiatives really came into full swing.

I'd like to share with you all my personal experience as a disabled worker, in terms of really feeling myself part of the team, just one more member finding out about myself and my career in GMV. And to do so I'm going to cherry pick some of my best personal experiences from among those I enjoy every day.

I mentioned beforehand that I began to work for GMV in September 2009. There was a cold snap that year and it snowed hard in Tres Cantos. I commute to work by car and on one of those snowy days, shortly after starting working here, I parked my car in the outdoor parking lot, and, walking very carefully so as not to fall over (the walking stick makes it three slip-prone points of contact), I made it into the GMV building. Unbeknown to me a colleague had been looking on, and since GMV is full of the highest human quality, this person mentioned it higher up in the firm without telling

POST: Head of Project / GMV Aerospace and Defense

DOB:
May 12, 1985

ACADEMIC QUALIFICATION: Higher telecommunications engineer

START DATE:
September 2009

OFFICE: Madrid, Tres Cantos

HOBBIES: Foody, movie buff, videogame and fantasy freak. Fond of sharing all the above with my loved ones. And, sometimes, proselytizing.

DEFINES HIMSELF AS: People addict, social junkie. I love chatting with the people who surround me and when I win a chuckle from them I consider it a success. At that moment, making others feel good makes me feel good on the rebound.



me anything. So imagine a fresh-faced Dani who had only just joined the firm, nervous about the unknown and determined to prove himself. Well, up to this ingénu in his workstation comes the Head of Facilities and says the following (I've tried as best as I can to remember the dialogue verbatim):

- "Hi Daniel, you park in the outdoor lot, right?"

- "Hi, yes I do..."

- "Well now you've got your own parking space, this one" -he indicated a spot on in the outdoor lot- "and you'll see the wheelchair symbol painted there".

- "Many thanks, I'm really grateful but there's really no need ..."

- "No, I know that, but we want that place to be exclusively yours".

His words were as forthright as they were caring. I can only repeat here my gratitude and ever since then you can see my car parked in a reserved slot with its own parking card.

A few months after starting to work on my first project I had to go to an

ESTEC meeting. I traveled with my line boss and another GMV colleague whose career path has since led him elsewhere. Before I could even begin to fill them in on my background they both came up to me to ask which additional traveling difficulties my disability might entail and let me know that they were there to help in any way they could. I remember both of them taking turns to push my wheelchair down the long ESTEC corridors. And this same situation has recurred on every subsequent work trip I've made during my ten-year GMV career so far, with the various colleagues and friends I've traveled with. Many names, examples and moments I treasure with tremendous fondness and admiration. Space fails me here to mention you all and for that I plead your understanding, but you all know who you are, and I'd like to take advantage of these lines to thank you for your help, support and for always being there.

So much for the career side of the picture, but at GMV fast friendships

are made too, true friends we also share leisure time with. With them I've traveled to national and international destinations: Andalusia, Barcelona, the Danube Delta, Warsaw, etc. Once more my memory might be selling me short here. Never for one single minute have I felt limited while surrounded by my friends, first and foremost, and, secondly, working colleagues. My heartfelt thanks to all of them! For carrying my crutches, for pushing my wheelchair or carrying me piggyback up steep staircases that seemed unsurmountable beforehand.

But the warm-heartedness doesn't stop there. My line boss once expressed his image of me a lovely dichotomy: "Dani, the fact is I see you and I don't see any difference from the rest. I see you as just the same and there are probably some things that I don't even notice, I'm just not aware of them". He said this by way of justifying himself. I took it as a compliment and as proof positive that my integration in GMV is complete: my disability is seen when it matters, and it's not seen when it doesn't. And it's a lovely dichotomy.



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