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Nº70

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THE FUTURE OF SPACE

INTERVIEW

DAVID
PARKER
Director of Human and Robotic Exploration
European Space Agency (ESA)

TALENT **Ángel Gavín:** «Journey or career move? For me, without doubt, it's been a journey»

PUSHING BACK THE LIMITS

On 9 and 10 October Madrid will host for the first time Space Congress 2019, which aims to bring Spain's space sector capabilities to wider notice, bring together all stakeholders in a common dialogue forum and look ahead at the challenges, opportunities and goals of the coming years.

Promoted by the Spanish Association of Space, Aeronautics and Defense Technology Companies (*Asociación Española de Empresas Tecnológicas de Defensa, Aeronáutica y Espacio*: TEDAE) and jointly organized by the National Aerospace Institute (*Instituto Nacional de Técnica Aeroespacial*: INTA), CSIC, the Industrial Technology Development Center (*Centro para el Desarrollo Tecnológico Industrial*: CDTI) and the Spanish MoD, the congress will bring together top space professionals, universities, public organizations and other institutions to raise the profile of Spain's space sector.

More information:
https://congresodelespacio.com/

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LETTER FROM THE PRESIDENT

GMV is now Europe's sixth biggest space company. Hundreds of meteorological, scientific, military and communications satellites are using GMV technology, the range of which takes in the entire ground segment and part of the flight segment. This number is about to multiply: OneWeb is currently launching the first mini-satellites of a 700-strong constellation to provide worldwide broadband connection.

GMV's expertise is also spearheading the exploitation of the huge swathes of data now coming from Earth Observation satellites, providing solutions that range from the mapping service for the European Community's external borders surveillance to applications for a more efficient management of vineyards.

The growing number of satellites and the trend towards large constellations of mini-satellites call for new launchers like PLD's Space Miura, the avionics of which is being developed by GMV. Also at a premium are new technologies for monitoring and reducing space debris, an area in which GMV's role includes the operation of Spain's Space-Debris Monitoring and Surveillance Center as well as the development of the guidance, navigation and control of the European Space Agency's future active debris removal missions.

These are only a few examples of space technologies that are essential for our activities on earth and in which GMV is a world leader; technologies that are bringing us forward to a future where humankind will colonize the Moon, land on Mars and conquer the Solar System.

Mónica Martínez

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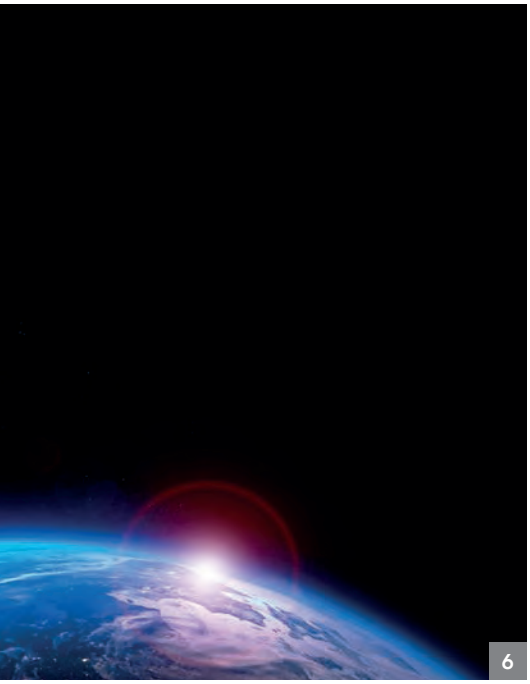
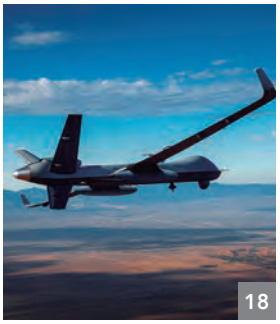
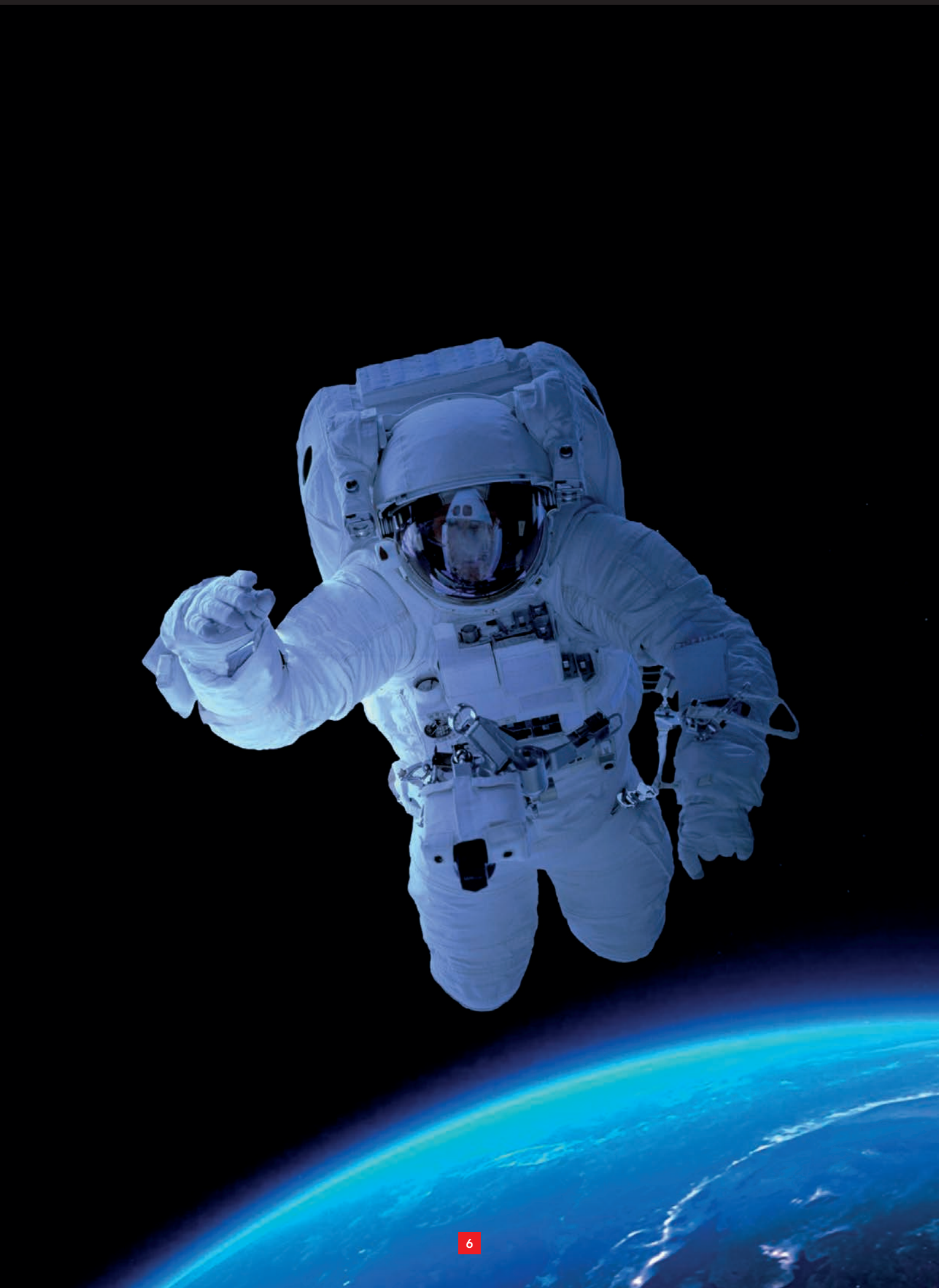






THE FUTURE OF SPACE

20 JULY THIS YEAR SEES THE 50TH ANNIVERSARY OF HUMANKIND'S FIRST LANDING ON THE MOON, A FEAT PULLED OFF ONLY 10 YEARS AFTER THE STARTING PISTOL OF THE SPACE RACE WAS FIRED WITH THE LAUNCH OF THE FIRST ARTIFICIAL SATELLITE, SPUTNIK

According to the Index of Objects Launched into Outer Space, kept by the United Nations Office for Outer Space Affairs (UNOOSA), a total of 8,378 objects have by now been launched into space, of which 4,994 are still orbiting the Earth. These satellites render many welfare- and security-enhancing services and have an increasingly big knock-on effect on the economy. Nonetheless, we are still in the infancy of a continually transforming industrial sector with a huge potential.

Space has traditionally been a top-priority investment for most of the world's major powers. Mindful of space's vast strategic value, governments are stepping up this outlay year after year, building up to 76 billion euros by 2017. In recent years this government investment has been boosted by a sizeable input of private capital. Space Angels estimates that private investment in the last 10 years added up to 16 billion dollars, two billion of which was invested in 2018 alone. Although this figure still lags well behind government investment, which is 40 times higher, it does show the growing attractiveness of Space to the private sector.

Indeed, the future of space is tremendously exciting. Sterling challenges await in the coming years, in areas or segments like launchers, navigation, communications, earth observation, space surveillance, planetary defense, space tourism, science and space exploration.

SATELLITE LAUNCHERS

Launchers are obviously of crucial importance in the ongoing development of the space sector. In the last 10 years we have witnessed an upsurge of new companies; pride of place here goes to SpaceX and Blue Origin, which have shaken up the launcher business and smartened up its supply range and competitiveness. This new context has also spawned many microlauncher initiatives (Rocket Labs, PLD Space, etc) and other alternative or rocket-complementing launch systems.

In the next few years we are bound to see a bigger supply range of launchers and a substantial cheapening of launch costs. This supply-side boost will undoubtedly give a huge push to the "new space" sector.

SATELLITE NAVIGATION

Satellite navigation is now in its heyday. There are now four global positioning systems, either fully up-and-running or well on the way to being so. All of them (GPS, GLONASS, Galileo and Beidou) provide positioning, navigation and timing services on a worldwide scale.

They are fleshed out by a set of regional systems (India,Japan and Australia); more of these look likely to come on stream in the future. They have by now become a basic global infrastructure and a driving force behind the economy, in a similar way to internet. As of today there is more than one GNSS-enabled device per inhabitant. According to estimates of the European Global Navigation Satellite System Agency (GSA) this number will continue to rise until reaching 10 billion by 2025. Over the coming years we will see a quantitative and qualitative growth of GNSS applications in mobility, transport, farming, construction, critical infrastructure and finance. We will likewise witness a rollout of more precise, robust services and the development of government applications. New generations of the current constellation will also be born, improving the robustness, reliability and performance of the system as a whole.

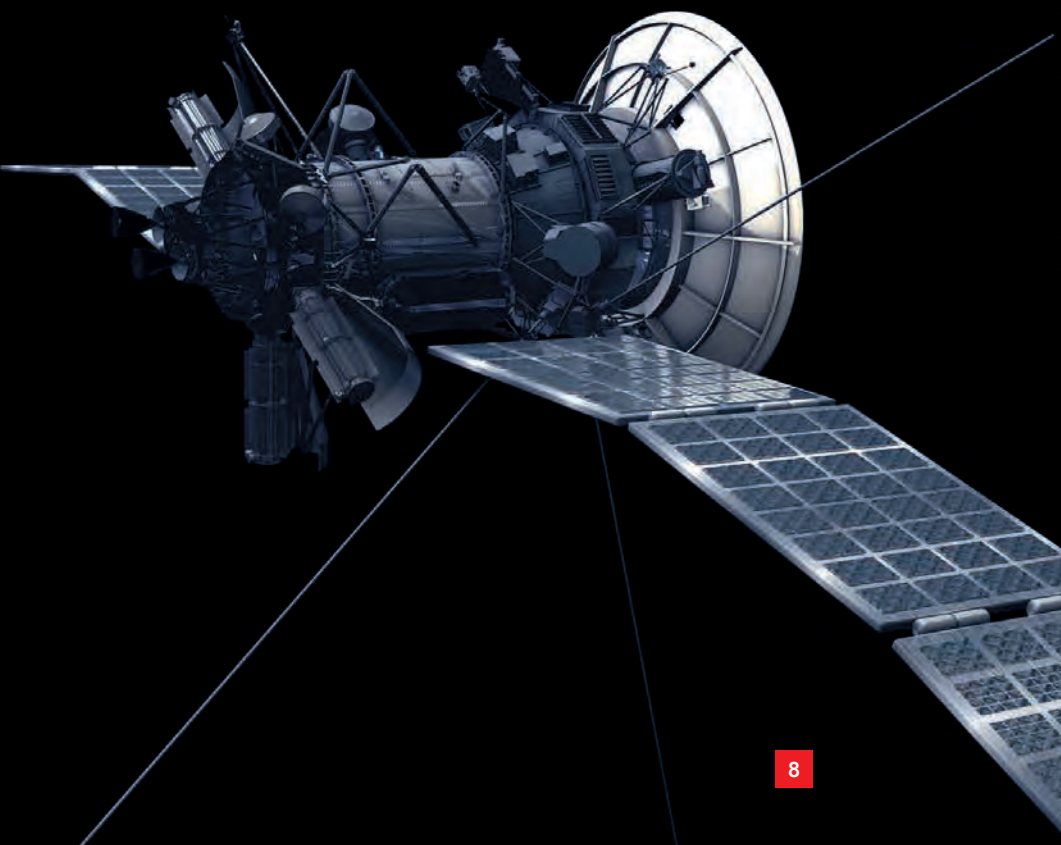
In particular, Europe's Satellite Navigation System, Galileo, represents Europe's all-time biggest space project. The number of Galileo-enabled devices is growing day by day. Next year Galileo will complete its operational rollout phase and from that point onwards we will see a nonstop increase of applications.

SATELLITE COMMUNICATIONS

Satellite communications have played a key role in the development of the space sector. This market segment is now undergoing a thoroughgoing transformation due to the switch in consuming habits towards mobile communications. This has called for a significant technological transformation because of the greater complexity of satellite-based mobile communications. The satellite's potential for closing the digital divide is therefore unquestionable. At the moment, although the built-up areas of the developed world have access to high-speed internet by means of terrestrial networks, 60% of the world's population still lacks a broadband service. Satellites are bound to play a standout role in bringing this broadband access to remote areas of the land, airspace or the sea.

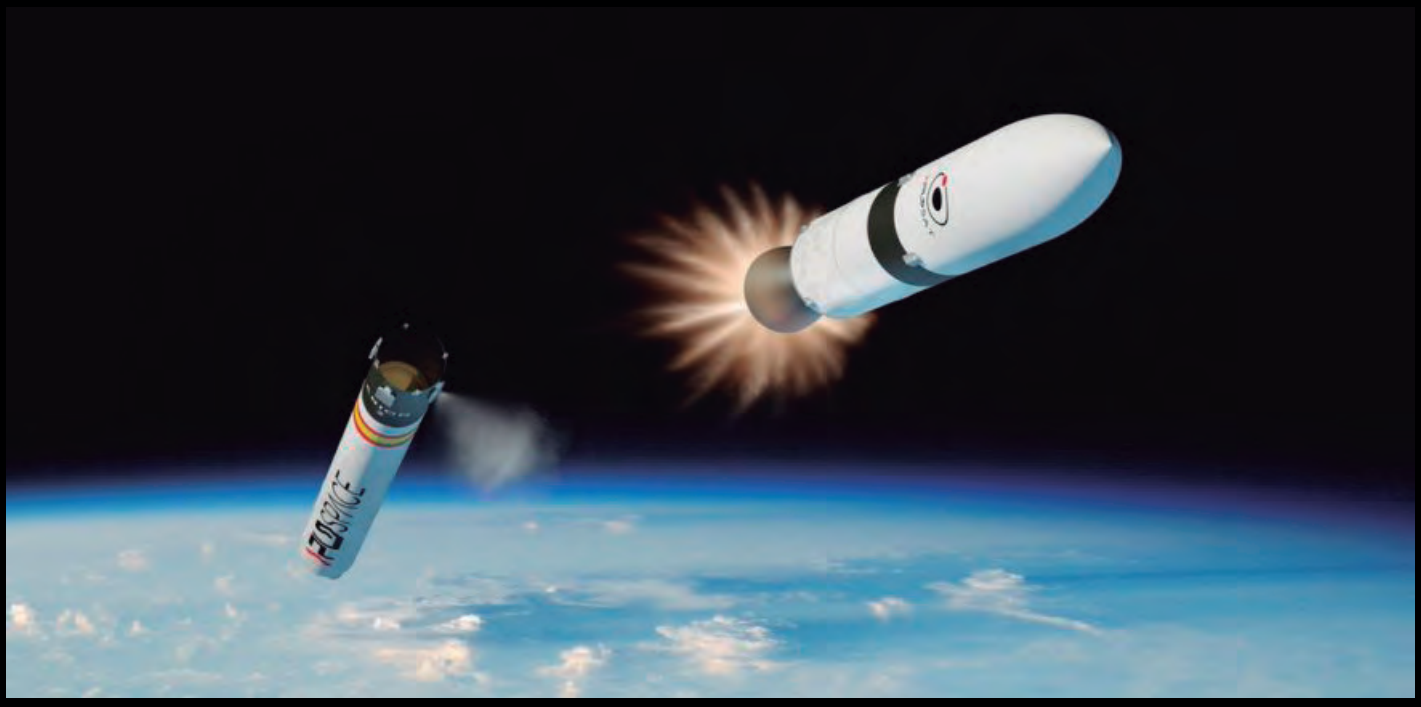
There are also several projects of low-orbit satellite constellations in the pipeline. Some of the more eyecatching projects involve the launching of hundreds or even thousands of satellites to complete the whole constellation; this represents a true paradigm shift. Although beset with undeniable economic and technical uncertainties, the next few years in this segment of the space market promise to be fascinating.

To all the above must be added the technological developments that are likely to be brought in by the rollout of the 5G system, which will also phase new capacities into navigation and tracking systems. New flexible payloads will be deployed and consolidated, ushering in quasi real-time reconfiguration of the transmission map and thus endowing the telecommunications service with an unprecedented immediacy.



SATELLITE-BASED EARTH OBSERVATION

Satellite-based earth observation systems have by now built up such high standards of quality, precision and global reach that they have become an essential aid in



weather forecasting and in monitoring the planet's state of health.

Satellite-based earth observation data is now being applied in such fields as disaster management, sustainable development, biodiversity protection, precision agriculture, defense and security, the fight against climate change and many more.

The European Union, well aware of the potential of these applications, is funding the Copernicus program, the world's largest satellite-based earth observation project, now with 6 satellites in orbit. Four more satellite launches under this program are scheduled in the next two years, with 9 further satellites in definition- and design-phase looking at the mid-term future.

This incomparable space infrastructure is rounded out by a production program of operational services in areas of great social impact (such as services for environmental, maritime or climate catastrophes) equipping users with the necessary means of data-access and use (by means of DIAS platforms) under a policy of open and free data. This institutional push is added to by private investment that has now been underway for several years. This investment presents a marked trend towards constellations of small satellites with the aim of increasing coverage and cutting down the revisit time.

The huge amount of data generated by these systems calls for groundbreaking changes in such fields as automatic processing or data analysis that harnesses artificial-intelligence techniques within decision-making support systems.

As geo-intelligent services make increasing inroads into the various markets, new business models are bound to be taken up and developed in the coming years.

In the longer term there will be a systematic development of integrated space systems providing high-precision, quasi-real-time earth observation images. This will multiply the number of applications

and facilitate the takeup of satellite-based earth observation systems in the everyday operation of many different businesses and government departments.

SPACE SURVEILLANCE – CONTROL OF SPACE TRAFFIC

As a result of humankind's activity in the 60 years of the space era there are now estimated to be 750,000 objects bigger than 1 cm orbiting the earth. Space debris now poses a real risk to space activities. It is now quite frequent for satellites to have to make correction maneuvers to evade collision risks; ESA had to make about 30 of these collision-avoiding maneuvers last year. In the future this space-debris risk will only get worse as space activity picks up further. There is also the possibility of some of these objects, including entire satellites, reentering the earth's atmosphere with potentially hazardous results.

The European Union has therefore set up a space surveillance program, rolling out a European space-debris-monitoring system that provides reliable orbit-collision detection risk. It can also identify vehicle fragmentation in space and weigh up the risk associated with the atmospheric reentry of any of these objects. Development of this European program includes an enhancement of observation/detection sensors, especially radar and telescope networks, plus the development of a datacenter that includes the best updated database giving information on potentially hazardous objects and provision of the identified services to the various users.

Before long space regulation is likely to be upon us; a space-traffic control system is also expected to be rolled out along the lines of air traffic control.

POTENTIALLY HAZARDOUS ASTEROIDS

Potentially hazardous asteroids are considered to be those whose orbit comes within a threshold approach of the earth's orbit and therefore pose a certain risk of collision with the earth.

The fall to earth of rock or iron asteroids with a diameter of over 50 m happens with a mean return period of one hundred years, producing local catastrophes and tidal waves. Every few hundreds of thousands of years, asteroids of over one kilometer cause global catastrophes. Such impacts have occurred in the past; they will continue to occur in the future and some have been blamed for large-scale extinctions.

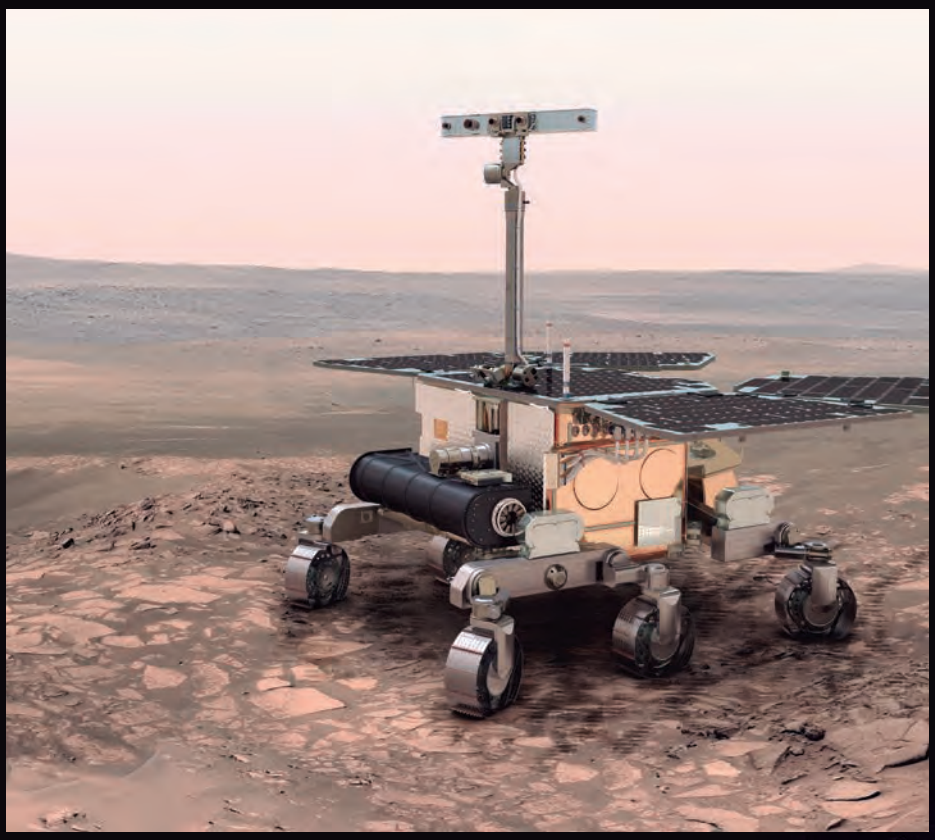
It is therefore essential to pinpoint these objects and study them to ascertain their size, makeup, structure and the best way, if necessary, of diverting them.

SPACE TOURISM

Private initiatives have been working away to set up space tourism for some years now. The most active companies in this field are SpaceX, Blue Origin, Virgin Galactic and Orion Span. The range takes in sub-orbital flights, stays of several days in the international space station, journeys to the moon or even Mars. Some of these initiatives are thought likely to gel in the next 5 years. In the medium term, therefore, space tourism is bound to feature prominently in the leisure industry.

SCIENCE AND SPACE EXPLORATION

Without any doubt science and space exploration constitutes the most



inspiring and futuristic space activity. It is the science and space-exploration missions that tend to push back the technology envelope, hogging the headlines and grabbing society's attention. Their sheer scale often calls for international cooperation too, so they represent symbols of cooperation and concordance between nations.

To date humankind has accomplished extraordinary feats in this field, including space observatories, the international space station, a great number of crewed flights, missions to other planets and probes to asteroids and the outer limits of the Solar System and beyond. Europe's ExoMars 2020 is now looming up on the horizon, to complete the ExoMars mission. This will include a rover to drill into and analyze the Martian soil, helping us to decide whether or not the red planet could harbor life now or have harbored it in the past. Europe is also working in collaboration with the Russian Space Agency, Roscosmos on its moon missions and will be providing crucial moon-landing technology in such areas as absolute and relative navigation.

The European Space Agency (ESA) is collaborating with the Canadian Space Agency (CSA) and Japanese Space Agency (JAXA) on the HERACLES robotics mission. This will be using the Deep Space Gateway, an ISS-like crewed platform that will be orbiting the moon and serving as base camp for other exploration missions. The design and development of this platform is being carried out jointly by ESA, NASA, Roscosmos, JAXA and CSA.

The USA government has recently announced the Artemis mission, under which a women will set foot on the moon by 2024. This mission will undoubtedly drive crewed flights and space exploration.

As well as the abovementioned initiatives there are also private space-exploration initiatives underway nowadays, most notably the Elon-Musk-led Space Exploration Technologies (SpaceX). This company plans to make a first robotics mission to Mars in 2021 and a crewed mission in 2027. The world's main space agencies consider the first humans likely to reach Mars a little later, by about 2030. Lunar bases are also being talked about nowadays, so it does seem clear that humankind will begin a colonization of the solar system in the not too distant future.

There is no doubt that robotics will be looming large in this fascinating future. Robots will not only foreshadow crewed missions but will also play an essential role in crewed missions and in the sustainability of human colonies outside our planet.


David Parker
esa

DAVID PARKER

DIRECTOR OF HUMAN AND ROBOTIC EXPLORATION EUROPEAN SPACE AGENCY (ESA)

David Parker became the European Space Agency's space exploration Director in April 2016. His first act was to propose the creation of the new European Exploration Envelope Programme, approved by Ministers at the Luzern Conference in December 2016. This integrated various existing ESA programmes into a single tool for delivering Europe's space exploration strategy.

From 2013 to 2016, Dr Parker was Chief Executive of the UK Space Agency, working with Government ministers to define and implement UK space policy. His initiatives included major investment in both commercial and exploration missions of ESA and the creation of the Harwell space cluster which now hosts over 80 organisations, including the European Centre for Space Applications and Telecommunications (ECSAT).

Other actions included the UK's International Partnership Programme which applies satellite applications to global development issues and championing the UK government's investment in the pioneering 'SABRE' air-breathing rocket engine project of Reaction Engines Ltd. During Tim Peake's mission to the ISS in 2016 and 2016, two million school students were involved. In total, he worked with five UK space ministers and participated in five ESA Ministerial Council meetings since 2005.

After joining the company British Aerospace Space Systems in 1990, David Parker worked for over a decade in the UK space industry, initially on technology development and studies of new scientific missions, with a focus on propulsion. He later managed the Guidance, Navigation and Control (GNC) team of Matra Marconi Space in the UK; and later moved to business development work at Astrium, winning ESA projects including LISA Pathfinder and Aeolus.

From 2004 to 2010 he worked at the UK Government funding authority for fundamental physics, astronomy and space science. He represented the UK at ESA's Science Programme Committee as well as its Programme Board for Human Spaceflight, Microgravity and Exploration, serving as its chair until 2012. He was the lead author of the Global Exploration Strategy Framework document, published by fourteen space agencies in 2007. This foresaw global coordination of robotic and human space exploration as a key step towards the horizon goal of humans one day reaching Mars.

Dr. Parker has a first degree in Aeronautics and Astronautics and a PhD awarded for research with NASA Langley Research Center. He is a Fellow of the Royal Aeronautical Society.

COULD YOU GIVE US A BRIEF ACCOUNT OF YOUR DIRECTORATE'S ACTIVITIES?

The Directorate of Human and Robotic Exploration leads ESA's space exploration programme. This means managing hundreds of contracts –big and small– with European industry and also working with the science community to define priorities for experiments. And a lot of time is spent understanding the wishes and goals of our member states – at the moment, eighteen of them participate in the European Exploration Envelope Programme or E3P.

WHAT BULLET POINTS WOULD YOU HIGHLIGHT OF THE EUROPEAN SPACE AGENCY'S EXPLORATION PROGRAM? WHICH AREAS AND DESTINATIONS IS IT TARGETING?

We are focused on activities to destinations where humans will one day live and work - which means Low Earth Orbit, the Moon and Mars

ISS

In fact, we have been working for humanity aboard the space station now for nearly twenty years - and last year we celebrated ten years of on orbit operation of ESA's Columbus laboratory. So the day-to-day operations of Columbus is a top priority. This includes not only our astronaut missions but also the dozens of science and technology investigations we are delivering for Europe's research community. We now also have the first industry-led European modules coming to the ISS. ICECubes (SAS, Belgium) is already inside Columbus and next year Bartolomeo (ADS, Bremen) will be mounted on the outside. This makes the possibility of being in space –for science, technology or business– much easier and more flexible than ever before.

Orion ESM

Then we have our big development projects. Literally the biggest is the European Service Module (ESM) for NASA's Orion spaceship. Thirteen tonnes at launch, this will propel Orion on missions to the Moon as well as providing the power, oxygen and water for the four crew. An industrial consortium, led by Airbus Defence and Space and including many other European companies, built the first ESM which was delivered to the Kennedy Space Centre last year. It will be used for an un-crewed test flight late in 2020. A second ESM is being built that will take astronauts on a mission around the Moon in 2022. Further Orion missions will support Moon surface exploration.

ExoMars

The first part of our joint mission to Mars with Roscosmos, the Trace Gas Orbiter (TGO), is performing well and delivering important science resulting. Its colour images of Mars are beautiful but the TGO's very sensitive detectors have so far not found methane in the atmosphere at the global scale. This is an interesting finding because NASA's Curiosity seems to have found methane at a specific location, which could imply active geology or maybe (and I think it is unlikely) active life. Making sense of these results will certainly tell us more about how the environment of Mars, something needed for future human explorers.

Meanwhile, the industrial team led by Thales Alenia Space are working hard on the next part of the programme

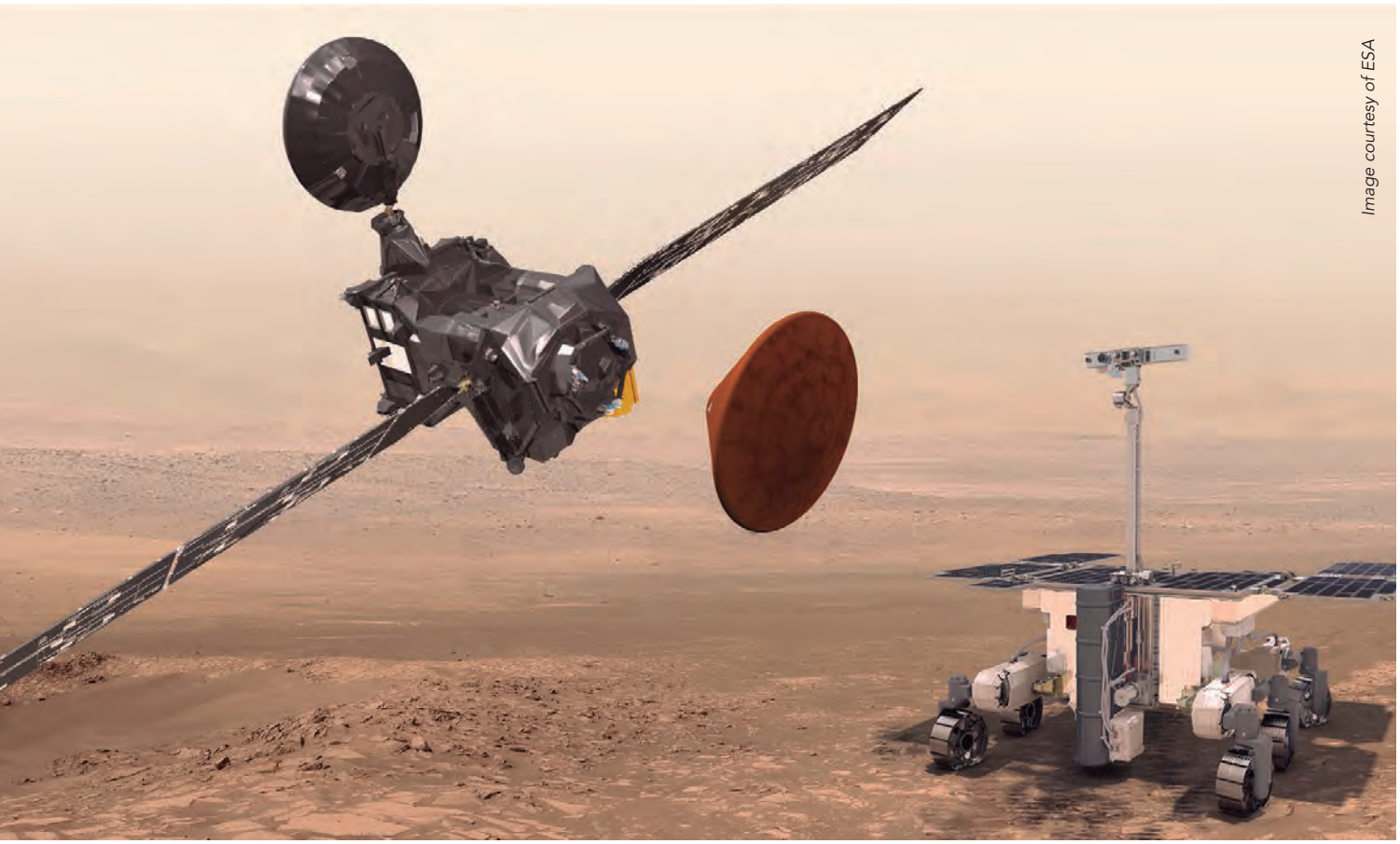


Image courtesy of ESA

which includes the Russian-led Descent Module and landing platform carrying the ExoMars rover named "Rosalind Franklin".

WHICH WOULD YOU CONSIDER TO BE THE MOST IMPORTANT INTERNATIONAL EXPLORATION MISSIONS CURRENTLY UNDERWAY, FROM BOTH THE SCIENTIFIC AND TECHNOLOGICAL POINT OF VIEW?

It's impossible to under-estimate the value of the International Space Station partnership in terms of the organisation, planning and technical skills needed to bring together all of its elements built on three continents 400 km above our heads. Beyond the scientific value is has returned, it has built a firm foundation for going further in human exploration.

The fast growing capability of China is impressive too – both in developing independent human access to space and in its robotic missions to the Moon, including the recent Chang'e 4 landing on the lunar far-side. But we in Europe can be proud of the robotic explorers of our Science Programme, including Rosetta's ten year voyage to Comet 67P/Churyumov-Gerasimenko, BepiColombo now on its way to Mercury and in the future, the JUICE mission to the Moons of Jupiter.

RECENTLY A DECLARATION OF INTENT RELATED TO MOON EXPLORATION HAS BEEN SIGNED WITH NASA. HOW DOES THIS CONNECT WITH EUROPE'S PLANS FOR MOON MISSIONS AND HOW CLOSE ARE EUROPE AND USA TO WORKING TOGETHER ON FUTURE MOON MISSIONS?

Both NASA and ourselves are interested in doing basic science about the Moon, its history and connection to the Earth. We are also both looking to promote opportunities to use commercial industry to support lunar exploration. So we have agreed to see how we can coordinate our efforts and get more science return, more quickly. This could involve flying instruments on each other's missions and sharing results.

ESA is already cooperating with Russia on its lunar robotic exploration with the Luna-Resurs Lander, looking for water ice on the Moon. For the future ESA is looking at missions to return samples of lunar material from unexplored regions or investigate the feasibility of using lunar resources to support human exploration. We are always open to cooperation.

Image courtesy of ESA

«In Europe can be proud of the robotic explorers of our Science Programme, including Rosetta's ten year voyage to Comet 67P/Churyumov-Gerasimenko, BepiColombo now on its way to Mercury and in the future, the JUICE mission to the Moons of Jupiter»

AND WHAT ABOUT MARS? WHAT IS THE CURRENT ROADMAP FOR EXPLORATION OF THE RED PLANET?

With ExoMars we are building on the success of ESA's Mars Express, launched in 2003. We see a robotic Mars Sample Return mission as a key next step – both because of the scientific treasure we can bring back to laboratories on Earth, but also as demonstrator of techniques needed for an eventual human Mars mission. We are hoping to work with NASA on this huge challenge. When we have learned how to live and work in deep space at the Moon, humans will be ready to make this historic voyage.

WHAT DO YOU THINK WILL BE THE MOST PROMISING INTERNATIONAL COOPERATION OPPORTUNITIES IN UPCOMING YEARS? AND WHAT WILL BE THE ROLE OF ESA AND THE EUROPEAN INDUSTRY?

Certainly the biggest single challenge is to extend human presence to the Moon is a sustainable way. By sustainable, I mean, not just racing to the Moon and then coming back, but building the infrastructure that will allow us to explore the Moon for months at a time. This includes increasing the reusability

«There is so much to do that it definitely needs a global effort. I am sure that ESA, through its member states, their industry and their research institutes have much to contribute»

of our exploration architecture; surviving the lunar night; protecting against the environmental hazards and perhaps being able to use the resources of the Moon - to "live off the land".

There is so much to do that it definitely needs a global effort. I am sure that ESA, through its member states, their industry and their research institutes have much to contribute. For example, we hope to build elements of the Gateway – our lunar spaceport; contribute further ESMs; and support European commercial exploration companies looking to provide transportation and telecommunication services in a 'lunar economy'.

AS FOR TECHNOLOGICAL ADVANCES, WHICH TECHNOLOGIES DO YOU THINK NATIONAL GOVERNMENTS AND COMPANIES SHOULD NOW BE CONCENTRATING ON TO WIN EUROPE POLE POSITION IN FUTURE SPACE EXPLORATION?

There's a long and interesting list of technologies we need to work on.

Propulsion

Challenges in propulsion for exploration missions are one of the top technology drivers, in terms of performance but also autonomy. The range of thrusts and other specifications needed is very wide, from attitude control up to big spacecraft 'tugs'. Both chemical and electric propulsion technologies are needed for a variety of future missions and space transportation systems.

Improved energy systems

A number of technology challenges for energy supply and better efficiency are specific for exploration. They range from fuel cells adapted to human spaceflight up to radioisotope power conversion for robotic and human missions, or improved photovoltaic solar panels. On a larger scale, a number of research activities are being started or reactivated in the US and China using small fission reactors, either for nuclear electric propulsion or for energy supply of a Moon base, especially during the 14 days night cycles.

Robotics and artificial intelligence (AI)

The number of Moon robotic missions will increase significantly in the next decade, therefore tele-robotics from Earth or from the Gateway are new possibilities. For robotic missions on Mars, more autonomous systems are needed due to the time delay. In future crewed missions to Mars, co-botics may also become a hot topic, as the number of crewmembers will be reduced to a very minimum. Artificial intelligence

will become the keystone to improve autonomy in robotics in general.

Advanced life support solutions
Current life support systems on ISS are limited in terms of recycling. However, the ISS is the only valid test bed for future life support technologies assessment to be used later on in deep spaceflight to Mars and on the Martian surface. The needs for advanced life support on the Gateway are limited, but they will become significant for sustainable Moon exploration, and be very substantial for missions to Mars and considerable for long stays on Mars.

Minimisation of exploration footprint
The driver to recycle on the ISS has not been high for the time as waste can easily be disposed by controlled atmospheric re-entry. For human Moon and Mars missions the need for waste reduction will become acute, as the cost of any kg of waste returned will be excessive, and permanent waste storage should be avoided. As an analogue, synergies can be found with Antarctic research stations where the waste challenges are identical. The technology will be relevant here in Earth in the drive towards smart-cities.

In space manufacturing
Spares for redundancy and repair will become one of the sizing elements for spaceflight beyond the Moon. Once on a Mars trajectory there is no U-turn possible. Additive manufacturing is a very good answer to this challenge, integrated into a mini-circular economy (waste/materials).

Space Resources/ISRU
Due to the issues of life support and waste management, ISRU can be an attractive solution to provide resources. Water for example can be of direct use for crews or electrolysed to serve as propellant (oxygen-hydrogen bipropellant, or possibly hydrogen in electric propulsion). There are nevertheless major unknowns on the extractability of these resources, and ultimately on the economic feasibility of ISRU. Both Moon and Mars have potential resources that must be studied. For example in combination with 3D printing (e.g. turning lunar regolith into building materials).

Radiation protection and mitigation
The number one potential health showstopper for deep space travel is cosmic radiation. Better quantitative and qualitative characterisation is needed in order to develop the right radiation protection. This aspect is important for habitats designs, e.g. water shielding from neutrons for example. Depending on the electric energy available on a spacecraft, active electromagnetic shielding based on superconductors may become an option.

Communication
The complexity of future robotic missions will drive communications needs. Deep space human exploration will need communications similar to the one on the ISS. But the way we communicate on Earth is advancing at an unprecedented pace. Maybe the general public will expect that they participate in space exploration missions through virtual "tele-presence". Crew activities on Moon, will need the right sensors and communications bandwidth in order to, for example, reconstruct near real-time holographic representations.

AND TO WIND THINGS UP, A MUST-ASK QUESTION THAT I'M SURE HAS BEEN PUT TO YOU MANY TIMES BEFORE. DO YOU THINK FUTURE SPACE EXPLORATION WILL BE A HUMAN OR ROBOTIC AFFAIR?
I believe that it's the combination of humans and robots working together that is the future of exploration. Robots can act as the precursors and scouts for human exploration – reaching places that are too risky or too little understood for humans. Of course the cost of a robotic mission is less than for a human one, but humans can still achieve a lot more and are more adaptable, especially in unforeseen situations. Eventually, to do the most important research, we need to live and work at the Moon and then Mars. Maybe in the far future, it will be some sort of robotically-augmented human that explores farther into the Solar System. Or maybe that's science fiction!

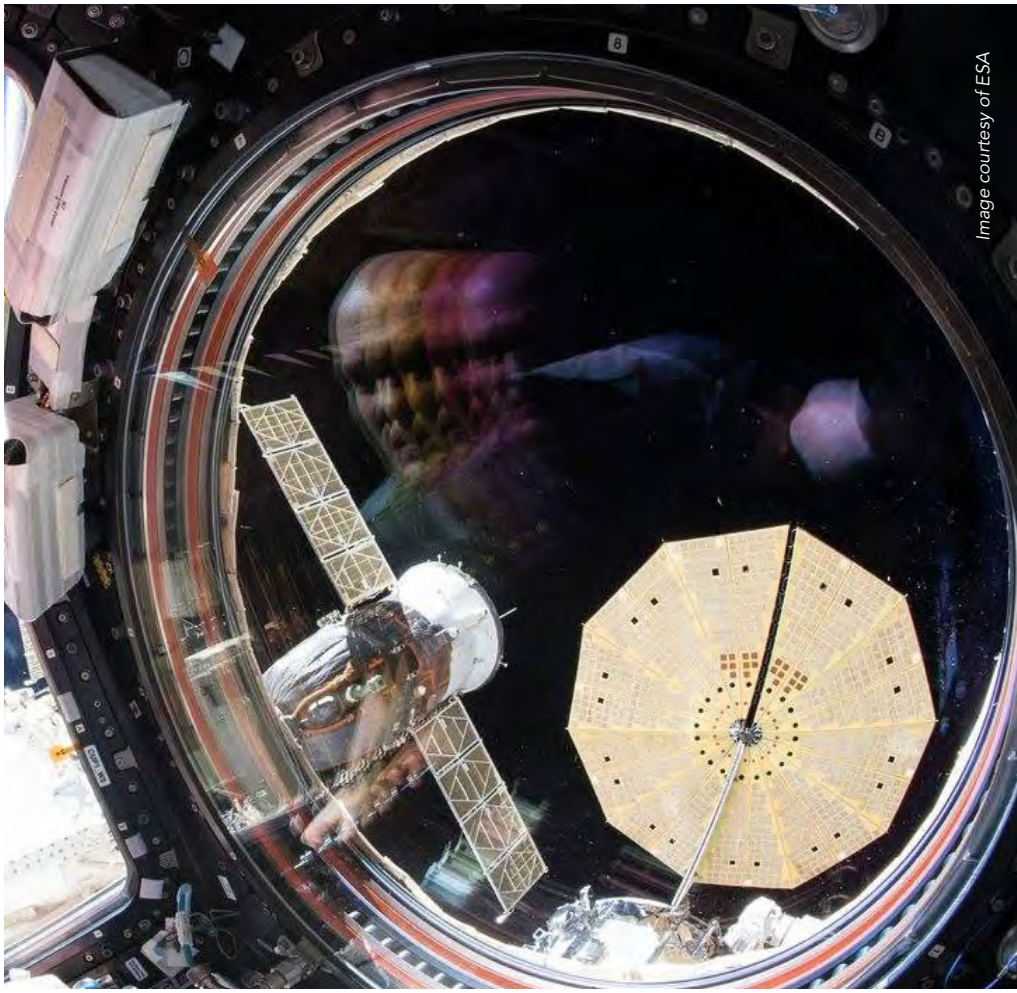


Image courtesy of ESA

The Spanish MoD turns to GMV for the ground technology of the MQ-9 Predator B drones

THE MQ-9 PREDATOR B WILL SUPPORT MISSIONS WITHIN THE NATIONAL TERRITORY, SUCH AS STRATEGIC MONITORING IN THE AREAS OF INTELLIGENCE, SURVEILLANCE AND MARITIME SECURITY OR DEFENSE, AERIAL OPERATIONS, HUMANITARIAN CRISES, BORDER CONTROL AND SURVEILLANCE, FIREFIGHTING OR THE FIGHT AGAINST TERRORISM

GMV has developed for the Spanish MoD the ground segment systems for capturing, storing and distributing information from the unmanned aerial vehicles MQ-9 Predator B, to be used from this year onwards in intelligence and surveillance missions. Drones, notably, now have a growing world market value in the military sector. The latest "ASD Reports", analyzing the markets of the United States, Europe, Asia and the Pacific, the Middle East and Latin America, puts the current value at over 7 billion euros.

These systems, known as Coalition Shared Databases (CSDs), receive images, real-time videos plus radar tracks and GMTI tracks and enable all this information to be distributed in real time to the armed force's intelligence and surveillance centers. The solution developed by GMV, going under the name of CSD-SIERRA, is now in service with the Spanish MoD and NATO's intelligence centers.

In late 2015 the Spanish MoD bought from General Atomics two ground control stations and four aircraft, worth in all 158 million euros. The first two drones and the two ground control stations will be received as from this coming summer; the third drone will arrive at the end of 2019 and the fourth and last in 2020. The MQ-9 Predator drones were chosen by the Spanish MoD because they are already in operation in other NATO countries like the UK, France, Italy and the Netherlands; this will make it easier to train up their pilots and share equipment on international missions, as need be.

These Remotely Piloted Aircraft Systems (RPASs), generically known as drones or Unmanned Air Vehicles (UAVs), will come into operation in the airbase of Talavera la Real (Badajoz). Unlike the many tactical RPASs currently flown by the Ministry of Defense, these four new vehicles are the first of the strategic type. The MQ-9 Predator B will be supporting permanent missions on national territory, such as strategic monitoring in the areas of intelligence, surveillance and maritime security or defense, aerial operations, humanitarian crises, border control and surveillance, firefighting, the fight against terrorism and organized crime, etc.

The MQ-9 Predator B drones are 11 meters long with a wingspan of 20 meters; they can reach a speed of 444 kph; their service ceiling is 15 km and they can operate 24 hours a day, seven days a week without being seen from earth, transmitting information in real time.

The MQ-9 Predator B carries no air-to-ground missiles. These capacities will be covered by the Euromale system, a European long-endurance remotely piloted aircraft project involving Germany, Italy, France and Spain.

AED Cluster Portugal announces its Board of Directors

On 29 March 2019, AED Cluster Portugal (AEDCP) officially announced the new Board of Directors, on which José Neves, GMV's Security and Defense Manager in Portugal, was appointed as the new President.

José Neves has been involved in the Cluster's activities since the very beginning, having participated in the creation of the PEMAS and ProEspaço Associations, around 2003 – two of AEDCP's three pillars. Most recently, in the last two years, he has also been a member of AEDCP's Board of Directors.

General José Cordeiro gave a welcoming speech to the new Board and officially handed over the presidency to José Neves in a ceremony held in AEDCP headquarters. According to General Cordeiro "*we have grown from a three-pronged viewpoint (Aeronautics, Space and Defense) to a project everyone can relate to. Today, we have a strategy for the sector's development and everybody knows his or her place and role within it*".

José Neves, for his part, expressed his thanks for the appointment and argued that "*We are now facing a clear growth potential. The effort and initial investments ensure a cohesive and fruitful future for AED*".

1st Legaldrone Congress

GMV took part in the 1st Legaldrone Congress to be held on 28 and 29 March under the joint organization of the Law School (*Facultad de Derecho*) of the Universidad Complutense de Madrid and the Spanish Association of Space and Aeronautics Law (*Asociación Española de Derecho Aeronáutico y Espacial*: AEDAE).

The aim of the congress was to analyze the current problems and challenges posed by legislation on remotely piloted aircraft systems at national, European and world level. It was done so by examining aspects to do with administrative law, intellectual law, penal and civil liability, among others. It also aimed to give a good idea of the technical notions bound up with aircraft of this type, in order to shed some light on the benefits and risks posed by current use of RPASs and the need for orderly regulation of the matter.

Working with jurists and professionals of recognized prestige, Legaldrone addressed not only the characteristic traits of aircraft or systems of this type but also the legislative framework in which they operate.

Within the congress, on 28 March, Ricardo Sáenz Amandi, GMV's Defense and Security Programs Manager, gave a chat called "Artificial intelligence: practical aspects".

Defense and Security event in Brazil with the presence of GMV

Brazil hosted the 12th Latin American Defense and Security Exhibition (LAAD). GMV formed part of the Portuguese delegation led by idD – the Portuguese Platform for Defense Industries.

LAAD, which took place in the capital of Rio de Janeiro in the beginning of April, is a leading Latin America Defense and Security event. On the previous occasion it attracted a turnout of 180 official delegations, more than 37,000 attendees and 450 exhibitors.

The exhibition brought together international and national companies that provide technologies, equipment and services for armed forces, special forces, police and homeland security, plus security managers from large companies, service concessionaires and critical infrastructure.

Besides its presence in the Portuguese pavilion, GMV's Director of Security and Defense in Portugal, José Neves, took this chance of meeting up with the public and private entities that attended the event.

GMV attends the seventh World ATM Congress

From 12 to 14 March the IFEMA Congress Hall in Madrid once more hosted the World ATM Congress, the national and international benchmark event of the aeronautics community.

Organized by the Civil Air Navigation Services Organization (CANSO) in collaboration with the Air Traffic Control Association (ATCA), this congress brings together developers, experts, providers and public air-navigation stakeholders.

This seventh congress attracted a bumper turnout of 250 companies and institutions to talk about the latest trends in the sector. For yet another year GMV ran a stand featuring all the following: the ***magicIFP*** web application for ground- and flight-validation of performance-based-navigation (PBN) procedures, recently contracted for a five-year term by Spain's main air-navigation services provider ENAIRE; a new double-band version of its interference detector ***srx-10i*** currently rolled out in 11 Spanish airports, and the ***emil*** system for ground inspection of ILS and VOR radio aids.

The Congress was organized around various sessions to debate such issues as the chronic shortage of trained personnel with the right skillsets, the integration of Unmanned Aircraft Systems Traffic Management (UTM) and the need of enhancing ATM and aviation skills.

During the congress GMV also took part in two lectures. One dealt with the EGNSS4RPAS project, on which it is working in collaboration with VVA, the consortium leader, and CATEC. Its aim is to standardize the use of EGNOS and Galileo in unmanned aircraft, displaying these systems' navigation and geofencing advantages. The second dealt with the GATEMAN project, being led by GMV for the SESAR Joint Undertaking (SJU), and designed for detection and localization from aircraft of GNSS-signal threats.

The XKY system features at Avionics Expo

GMV attended the tenth Avionics Expo, held in the MOC Veranstaltungscenter München tradefair site in Munich (Germany) on 12 and 13 March.

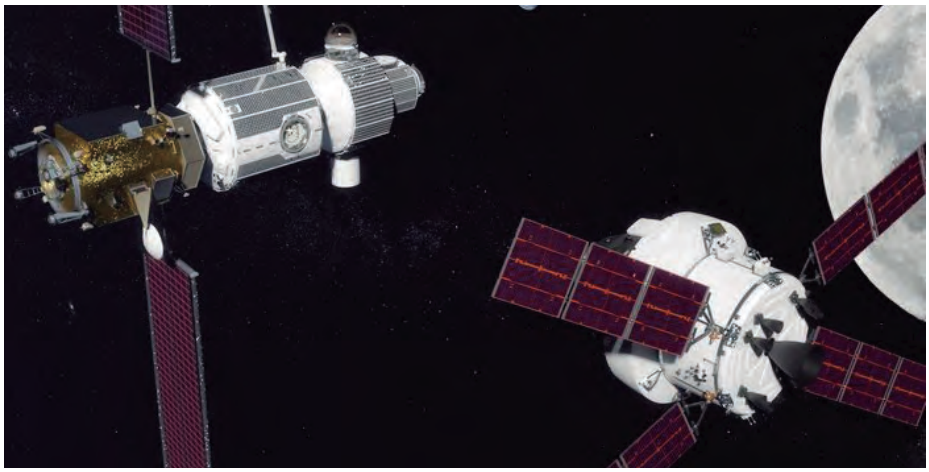
From its whole portfolio of inhouse avionics developments, GMV showcased at the fair its latest product, ***XKY RTOS***.

XKY is a groundbreaking commercial operating system currently being developed by GMV, to an assurance level compatible with the highest aeronautic certification requirements (DAL-A). Intended to serve as the backbone of an integrated modular avionics (IMA) implementation, ***XKY*** is an ARINC 653-compliant time-and-space partitioned real time operating system (RTOS).

GMV made a big impression at the fair. Its stand, running a wide range of ***XKY*** demos over several aeronautical scenarios, received a notable number of visits. Our team also ran a plenary session presentation exploring some of the modern avionic challenges that IMA can address and explaining the main features of the ***XKY*** partitioning operating system.

Avionics Expo was held as part of the Aerospace Technology Week, the encounter that features the latest breakthroughs, trends and challenges of the air-navigation sector. For two days the German tradefair site hosted three events in a single space: as well as the abovementioned Avionics Expo, for the defense and commercial sector, the other two events were Aerospace Testing Europe, for aircraft design, construction and maintenance, and Connected Aircraft Europe, focusing on airline operators.

GMV designs the guidance and navigation system of the HERACLES mission



The technology multinational GMV has taken on responsibility for designing the Guidance, Navigation and Control (GNC) system of the international mission HERACLES, which signifies human return to the moon. The European Space Agency (ESA) is leading this mission, to which also the Canadian Space Agency (CSA) and the Japanese Space Agency (JAXA) are contributing.

The mission sets out to return samples from the moon with a European developed spacecraft. A Canadian rover collects these samples on the lunar surface during a two-month period. It does this in permanent liaison and coordination with the future lunar Gateway, from where the samples eventually will be returned to Earth. An additional European contribution is an interface element that deploys the Rover on the lunar surface. Japan develops the propulsive stage that lands the complete robotic stack on the moon. After the return of the samples, the rover will continue to explore and scout the Moon in preparation for human missions for up to a year.

The HERACLES mission has to meet several concurrent technological challenges such as: to demonstrate human-controlled subsystems, like propulsion, guidance, navigation and control; to test communication technologies and to control the mission from Earth, or from the astronaut-run Lunar Gateway.

In the international HERACLES mission GMV is leading the consortium that is designing the Guidance, navigation and Control system for the ascent from the moon's surface, for orbit transfer and for rendezvous and docking with the Gateway. In collaboration with GMV personnel in Portugal and Thales Alenia Space France and Italy, GMV will be developing a trajectory analysis tool for analyzing the transfers from low moon orbit to the NRHO orbits and for the rendezvous in the NRHO orbit. This tool will serve as the basis for the guidance function. GMV will also take on the design and development of the guidance, navigation and control (GNC) system and implementation of onboard algorithms, plus demonstration of a GNC prototype for trialing the technology of this future mission.

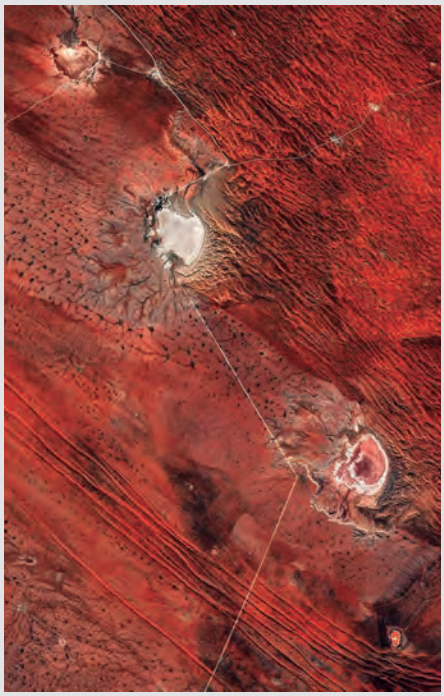
At the same time GMV is also responsible for the GNC of the rendezvous and docking phase in one of the system studies, the Thales Italia-led ESA study for designing HERACLES's rest component.

Earth Observation for sustainable development

On 13 March the GMV-led Climate Resilience Cluster organized in Nairobi, Kenya, the "EO4SD Climate Resilience Stakeholder & Capacity Building workshop" to show the value of earth-observation data for establishing climate-change-resilience strategies in developing countries.

Climate Resilience forms part of the European Space Agency (ESA)'s Earth Observation for Sustainable Development (EO4SD) initiative. The project consortium is made up by several benchmark European organizations in various fields of specialization: climatology, earth observation, data-visualization and -processing software, teaching, climate-service development, etc.

The workshop brought together representatives from International Financial Institutions (IFIs) and their client states to demonstrate the value of satellite earth-observation data for climate-resilience development, doing so by means of a series of presentations, discussions, and whands-on training.



GMV takes part in the "Mars Sample Return" mission

GMV IS PARTICIPATING IN THREE KEY ACTIVITIES OF THIS MISSION, WHICH COMPRISES AT LEAST 3 EARTH LAUNCHES PLUS ANOTHER ROCKET LAUNCH FROM MARS. ITS GOAL IS TO COLLECT MARTIAN SOIL SAMPLES, STORE THEM AND BRING THEM BACK TO EARTH

GMV is taking part in the Mars Sample Return (MSR) mission, jointly run by the European Space Agency and NASA, which aims to make further headway in the exploration of Mars and bring Martian soil samples back to our planet.

Running from 2020 to 2030, the international mission will comprise at least three launches from Earth and one more rocket liftoff from Mars, with the purpose of collecting Martian soil samples, storing them and bringing them back to the Earth, where a team of international scientists will perform detailed analysis.

In the first part of the mission, scheduled for the first part of the decade, NASA's Mars Rover will be exploring the planet's surface, collecting and documenting a series of samples that will later be retrieved for return to Earth. The next steps of the overall mission will be taken by NASA's Sample Retriever Lander, which will deploy on Mars a platform from which the Sample Fetch Rover (SFR) will head out, as part of Europe/ESA's contribution, to retrieve the samples previously cached by NASA's rover, compile and store them.

Once the SFR has retrieved the samples it will return to the platform and load them in the NASA-developed Mars Ascent Vehicle (MAV), which will blast off from Mars to take the samples into Martian orbit inside an Orbiting Sample (OS) container.

With the samples now in orbit, ESA's Earth Return Orbiter (MSR-ERO) will now swing into action, navigating to the Martian orbit to locate and capture the small sample container (a 20-cm diameter canister) to bring the samples back to Earth. To prevent any contamination back on our planet the samples will be sealed in a biocontainer system.

GMV is taking part in three activities within this mission. Firstly, it leads the rendezvous GNC system of the Earth Return Orbiter (MSR-ERO). Secondly and in parallel, as part of one of the Phase A/B studies of the Earth Return Orbiter and led by Thales Alenia Italy, GMV has responsibility for guidance, navigation and control (GNC) in the search, rendezvous and capture phases of the Martian sample container.

Finally, as part of the activities of the Sample Fetch Rover, SFR, GMV is working in the two consortiums that are currently designing two possible solutions at system level.

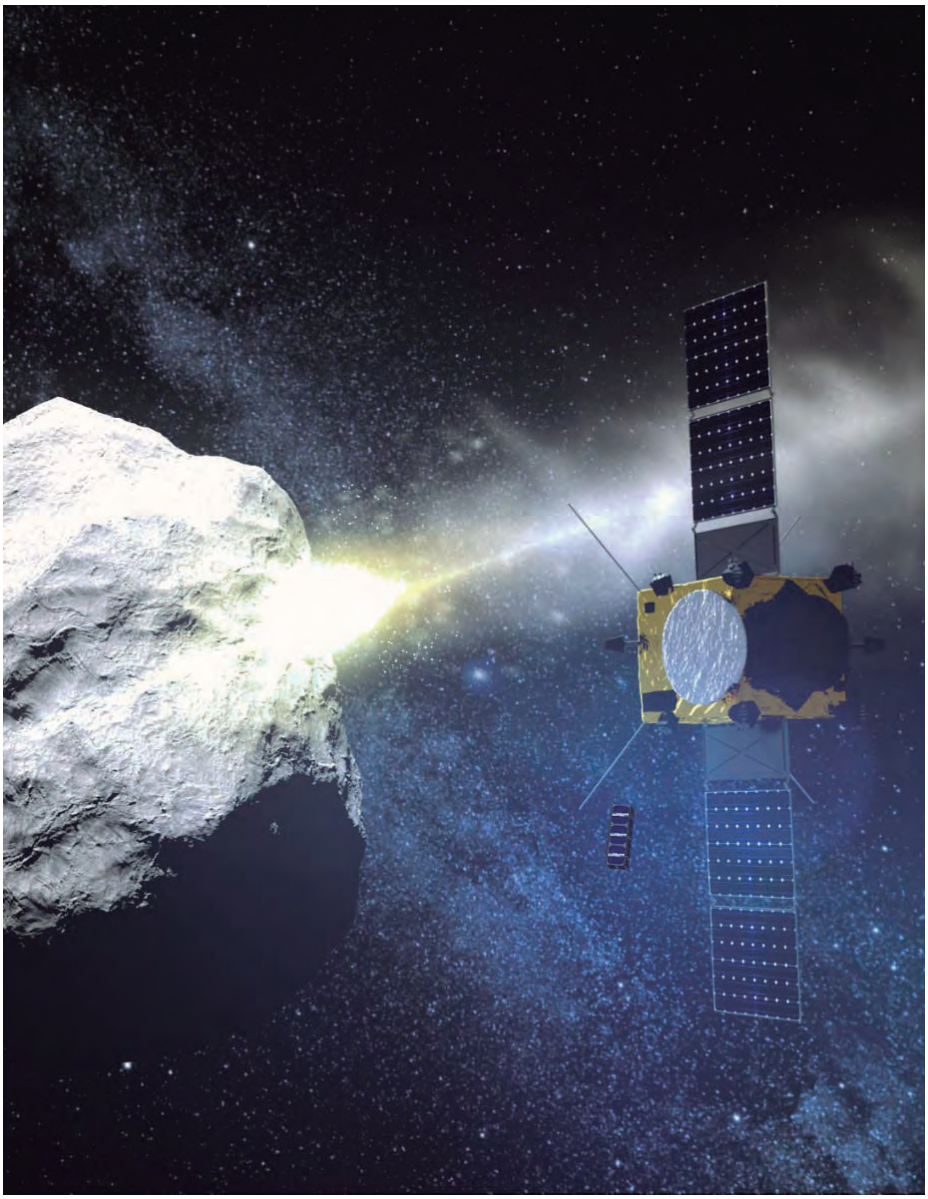
GMV responsible for the GNC system of Juventas, the CubeSat carried onboard HERA

GMV is participating in the international consortium responsible for designing Juventas, a CubeSat to be carried onboard the planetary defense mission HERA. Within a large international consortium led by GOMspace from Denmark, GMV in Romania is in charge of designing the guidance, navigation and control (GNC) system and mission design, while the Royal Observatory of Belgium is leading the scientific aspect.

HERA, run by the European Space Agency (ESA) and led by OHB-System AG, aims to develop planetary defense technology against any possible asteroid strike. Building on the forerunner Asteroid Impact Mission (AIM) project, Hera is set to be humankind's first mission to a binary asteroid system, Didymos, comprising a main asteroid orbited by a secondary one, like a small-scale earth-moon system.

Juventas, taking its name from the daughter of the goddess Hera and goddess of youth, will be released in the vicinity of Didymos. The tiny size of this nanosatellite, together with its relative cheapness and speed of development, will enable it to make a detailed characterization of the secondary asteroid. Juventas's close approach of the asteroid would be unsafe for the mother ship itself, so it will avoid jeopardizing the HERA mission as a whole.

The CubeSat will be carrying out key scientific operations to determine the composition of the secondary asteroid Didymoon. It will also be mapping the surface of the asteroid and characterizing the crater caused by the impact of NASA's DART probe. Several of Juventus's instruments will also be characterizing the main asteroid. The CubeSat's systems also include the groundbreaking Inter-Satellite Link (ISL) system, which allows



relative navigation between satellites. This is the first time this new system will be used in outer space, thus increasing the navigation precision in all operations.

The nanosatellite will also be turning to its favor the particular environment around the asteroids, where the solar radiation pressure can match the gravitational pull of the main asteroid, given its tiny mass. This effect plays an important role in the existence of stable orbit families that will make up the trajectory of Juventas, otherwise it would stray from its proper course.

Juventas's operations will provide an added value to the HERA mission as a whole, boosting its fund-raising potential ahead of Space 2019 in Seville, where a decision will be taken on ESA funding over coming years. If it raises the necessary funds HERA will once more place Europe in the forefront of planetary exploration, science and technology, echoing the huge success of the Rosetta mission.

GMV helps to improve onboard software development for satellites

GMV is leading the European Space Agency (ESA)'s MODEX project (Model exchange for Software Engineering), which aims to further define and improve the onboard software development process, focusing on the information exchanges needed between engineering teams participating in space mission design, especially those teams working outside the SW domain such as system and avionics engineers.

Working from the known and applicable ECSS standards, and leveraging the advanced concepts of the Onboard Software Reference Architecture (OSRA), MODEX will thoroughly define the stakeholders and roles associated with the development process, as well as collecting and modeling the required engineering exchanges. Here, some of the information exchanged will also be defined in detail and modeled, the goal being to address the challenges in maintaining and sharing a coherent model at semantic level that is independent of specific short-lived engineering methods or tools.

The results of the activity will also contribute to the development of ESA's SW Factory, a framework to streamline OBSW development for space. By addressing the exchange-data needs, MODEX will help to define systems in a more efficient and interoperable way via the SW Factory.

Exploring the potential of the model-driven approach to software and systems engineering, MODEX aims to become a keystone of the current trend towards the application of co-engineering methods and system-software integrated processes.

Leading this initiative, with the collaboration of TASF, SCISYS and TERMA as subcontractors, places GMV in pole position ahead of future R&D activities in this technology.

Space from a legal angle

On 21 February, the Madrid Lawyers' Association (*Colegio de Abogados*) held a conference entitled "Prospects for the space sector in Spain: a global vision", an event which focused on aeronautical and space law.

Jorge Potti, General Manager of Aerospace at GMV and Vice President of TEDAE's Aerospace Committee, attended the event to explain the current situation in which the Spanish space sector finds itself and its future prospects. As well as Jorge Potti, Carlos de Salas Murillo, Brigadier General Head of C4ISR and Space Systems at the Directorate General of Material and Armaments, and Juan Carlos Cortés, Director of Space, Large Facilities and Dual Programmes at the CDTI, also participated in the event.

Jorge Potti highlighted the important role of Spain in the Space sector, especially in projects like Galileo and Copernicus, as well as the fact that Seville will host the next ESA's Ministerial Council. On behalf of the Directorate General for Armament and Materials, Carlos de Salas explained the Space Systems Master Plan that the Ministry of Defence is putting into motion, the objective of which is to provide support to the sector as regards Spanish operational space capacities, in the technologies and with respect to international cooperation. On behalf of the CDTI, Juan Carlos Cortés spoke about the challenges facing the space sector in Spain.

This event was organised by the Section of Aeronautical and Space Law of the Madrid Lawyers' Association, an institution with a long track record in acting on behalf of the legal profession.

CYBELE, High Performance Computing´s potential for precision agriculture and livestock farming

From 28 to 30 January the Rectory of the Universitat Politècnica de Catalunya (Polytechnic University of Catalunya) hosted the kickoff meeting of the CYBELE project (Fostering precision agriculture and livestock farming through secure access to large-scale HPC-enabled virtual industrial experimentation environment empowering scalable big data analytics).

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

CYBELE has a 3-year timeframe to show how the convergence of HPC, Big Data analysis, cloud computing and IoT could revolutionize agriculture, boosting foodstuff supply and reducing food scarcity, generating social, economic and environmental benefits. CYBELE aims to ensure that the various stakeholders have unmediated, integrated access to a vast store of large-scale datasets of diverse types from various sources, doing so in such a way as to generate value and extract useful insights. The idea is to afford secure access to large-scale HPC infrastructure that supports data discovery, processing, combination and visualization services, solving modeling challenges that call for a high computing power.

In this project GMV is leading one of the nine pilots to assess and demonstrate the use of these technologies as applied to precision agriculture and livestock farming, focusing on the development of climate services as decision-making support systems for orchard management. In particular this demonstrator involves co-designing an early warning system for hailstorms and frost in orchards (peach, persimmons and citrus fruits), doing so jointly with the Valencia Region Agrofood Cooperative Federation (*Federación de Cooperativas Agroalimentarias de la Comunidad Valencia*: CACV) and the Italian Inter-University Automatic Calculation Consortium (*Consorzio interuniversitario per il calcolo automatic*: CINECA). This early-warning system would be based on earth observation data (from satellites and *in situ* sensors), weather forecasts, crop modeling and advanced data-analysis tools.

GMV attends the latest ISSFD

GMV presented 5 papers in the 27th International Symposium on Space Flight Dynamics (ISSFD), held from 24 to 28 February in Melbourne to coincide with the 18th Australian International Aerospace Congress (AIAC18).

ISSFD forms part of a series of symposia sponsored by various space agencies, including APL, CNES, DLR / GSOC, ESA / ESOC, EUMETSAT, INPE, JAXA / ISAS, KIAM, NASA / GSFC and JPL. It aims to furnish an international forum for flight-dynamics specialists.

Portugal Space presents the new Portuguese Space Agency

THE BIRTH OF THE PORTUGUESE SPACE AGENCY WILL DRIVE THE NATIONAL SPACE SECTOR AND FAVOR A MORE DIRECT MANAGEMENT OF THE DEVELOPMENT OF SPACE INFRASTRUCTURE, THE PROMOTION OF INITIATIVES AND PROGRAMS AND THE PROVISION OF SPACE-RELATED SERVICES

On 28 March 2019 Lisbon hosted "Portugal Space, ESA and the European Space Program (2021-2027)" organized by PERIN (Portugal in Europe Research and Innovation Network). During this event Manuel Heitor, Portugal's Minister of Science, Technology and Higher Education, presented Portugal's agency and its vision.

Also present at this opening session of Portugal Space were Chiara Manfletti, President of the agency, Luís Santos, Vice-President, and Rui Meneses, External Communication consultant at the European Commission.
The birth of Portugal's Space Agency, headquartered on the island of Santa Maria de Azores, will drive the national space sector and will also favor more direct management of the development of space infrastructure, the promotion of national space programs and initiatives and the provision of space-technology and -science services.

Portugal Space will come on stream during this month of April and the first small-satellite launches are scheduled for early 2021.

Teresa Ferreira, GMV's Space Director in Portugal, took part in one of the panel discussions together with other experts and leaders from scientific institutions and companies. This panel argued that "a backup of investment in the space sector is crucial to boost the technological maturity of our national space business and promote our firms' progress in the value chain".

The overarching aim of these events is to bring to wider notice the research designed to guarantee an effective convergence strategy for the Europe of Knowledge up to 2030.

GMV supports Kari's operations under the GEOKOMPSAT program

KARI (Korean Aerospace Research Institute) is using GMV's ***focusleop*** software (part of the ***focussuite*** flight-dynamics product) for the LEOP mission analysis, preparation and operations of the two satellites of the GEOKOMPSAT-2 program (GEO KOrea Multi-Purpose SATellite).

The GEOKOMPSAT-2 program, owned, manufactured and operated by KARI, aims to develop two geostationary orbit satellites, the meteorological GEO-KOMPSAT-2A (GK2A) and the ocean- and environment-monitoring GEO-KOMPSAT-2B (GK2B).

The GMV-KARI collaboration for this mission started in July 2015 with the first deployment of the software and the training of KARI's flight dynamics engineers. Since then there have been 3 years of close cooperation working together in system setup, maneuver strategy optimization and mission planning.

In late 2018 two GMV engineers joined the GK2A satellite operating team in the operating center of the Korean Aerospace Research Institute (KARI) in Daejeon (South Korea). The satellite was launched in December 2018 and, with GMV's help, reached its orbital position three weeks later.

The main tasks carried out by the flight dynamics engineers during LEOP operations were satellite-orbit determination, based on the tracking measurements from the ground stations, and the regular update of the optimal maneuver strategy according to the latest estimated orbit. Both tasks are of critical importance to raise the orbit of the satellite to the GEO altitude and also crucial to place the satellite safely into its narrow slot in the GEO ring. GMV engineers' flight-dynamics expertise was of paramount importance in detecting and correcting unexpected deviations in the ground stations' measurements calibration, to achieve an accurate orbit determination in highly demanding scenarios and to find optimal solutions for maneuvering the satellite, especially during final station acquisition when moving GK2A into its final GEO window while safely avoiding any neighbor satellites.

The GK2A satellite will improve the accuracy of precision weather monitoring and weather forecasting, as well as the capability of monitoring and forecasting extreme weather in the Korean Peninsula and the Asian region.

Collaboration continues for the next satellite GK2B which will be launched in Q1 2020.

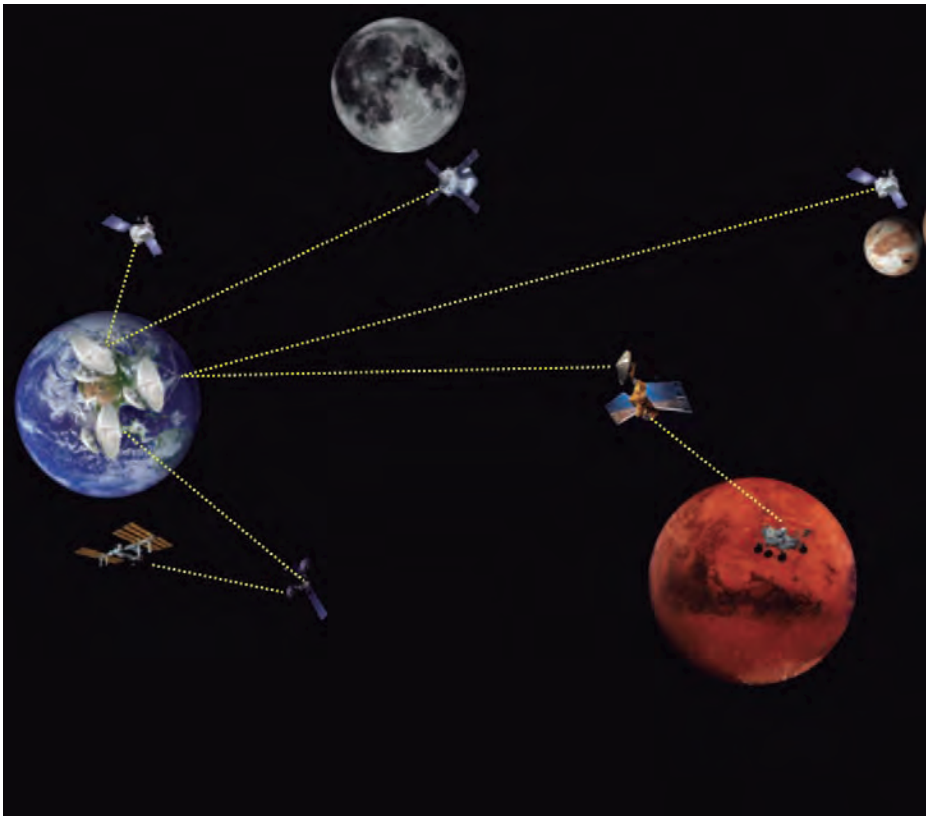
GMV, 2018 Prize for Excellence

GMV has been awarded the 2018 aeronautics Prize for Excellence in the Space category by the trade review Avion Revue Internacional (ARI). This is the second time the ARI Awards have been held, the only independent award scheme hailing excellent company performance in this sector.

Avion Revue awarded GMV this prize on the strength of its recent winning of the contract for maintenance and upgrading of the Galileo satellites' Ground Control Segment (GCS). This contract recognizes not only GMV's high skills level for carrying out this work but also its past experience and expertise built up over the years, making it the world's number one independent supplier of ground control systems for commercial telecommunications satellite operators and European leader in the ground segment of navigation systems.

This project cements GMV's worldwide leadership in satellite ground control systems and sets it up as a worldwide beacon in advanced Cybersecurity services and solutions, a crucial factor in secure access to information of the Galileo constellation.

GMV breaks new ground in the application of new communication technologies



Every day satellites collect a wealth of information about Earth, but they have to send it down to the ground before we can make use of it. Sometimes this data might be lost, damaged, or delayed, but our access to it could be improved using Delay Tolerant Networks (DTNs).

DTN (Delay/Disruption Tolerant Networking) is a new emerging communication technology to address the technical issues of delayed/disrupted network connectivity, particularly occurring in the space segment, e.g. inter-satellite communication or interplanetary internet.

Supported by ESA´s Discovery and Preparation Programme, a consortium consisting of Solenix, DLR, University of Bologna and GMV in Spain under the lead of GMV INSYEN has carried out a one-year study of how to set up a DTN driven Space Internet around Earth and to examine its possible advantages.

The study comprised the identification and implementation of representative scenarios for DTNs for flexible communication with Earth Observation satellites, in the interests of maximizing station utilization and supporting emergency communication.

The proof of concept of these scenarios has been achieved using representative simulators and automated configuration algorithms, e.g. for the routing configuration generation. Last not least, the consortium proposed a rollout strategy and roadmap for DTN introduction and a break-even point for investment.

GMV present at the biennial event SESP

Portuguese and Spanish GMV representatives attended the Workshop on Simulation for European Space Programmes (SESP), held in the Netherlands from 26 to 28 March.

Organized every two years by the European Space Agency (ESA) since 1990, SESP's scope was widened in 2010 to include the subject areas and organizational functions of the closely related Workshop on Electrical Ground Support Equipment (EGSE), which had previously been organized as a separate event.

SESP workshop is a uniquely focused forum where representatives of space agencies and industry can present and discuss the current state-of-the-art as well as future trends and needs. As such it also provides a rare opportunity for system developers and users to meet outside a contractual context, in order to share experiences with related tools, techniques and practices.

From Portugal, GMV presented a poster entitled "Integrating TOPE with EGS-CC" summarizing the outcomes of an activity carried out together with ESA. This activity showed the feasibility of migrating existing SCOS-2000-based Central Checkout Systems to EGS-CC, using adaptors and without having to rewrite an existing TOPE code base. Furthermore, these adapters were validated in ESTEC's Avionics Test Bench.

SESP workshop also aspires to serve as an exchange forum for new ideas and to trigger and encourage plans for future work. On the subject of industrial policy, ESA anticipates feedback from National Agencies and the Industry on new R&D activities, and on the expected role of ESA within the professional Simulation and EGSE community.

Innovation prize for the Sensing4Farming smart farming project

On 21 March Madrid hosted the Autelsi prize-giving ceremony. This fifteenth award scheme hailed Vodafone's Sensing4Farming initiative and DigitalGlobe as applied to the Bodegas Emilio Moro winery, praising in both cases the technological, productivity-boosting innovation.

Sensing4Farming represents a new paradigm in the world of smart, digital and precision farming. GMV is acting as technological provider to this trailblazing initiative in the application of IoT-based field-sensing technology to earth observation for the processing of satellite data and advanced and integrated analysis of Big Databases.

The solution taps into GMV's ***WInEO*** service for the advanced analysis of geospatial data to support decision-making procedures in farming. The most advanced satellite-data analysis technologies integrated with data from several ground sensors provide information on the crop growth of the vinery and high added-value agroclimate indices for vineyard management.

Thanks to Sensing4Farming, Bodegas Emilio Moro will improve the management of its vines, its crop quality and replicability and cost control while also cutting down the consumption of water, fertilizers and power to reduce the overall environmental impact.

The Autelsi Awards have now become a benchmark prize-giving scheme in the information and communication technology sector, recognizing the innovation and excellence of projects and initiatives carried out by both public and private organizations in this field, as well as the standout ICT-driving institutions.

Malaga hosts the first small-satellite congress

On 7 and 8 March Malaga hosted the Spanish Small Satellites International Forum (SSSIF), Spain's first international small-satellite congress, jointly organized by Spain's Industrial Technology Development Center (CDTI in Spanish initials), ESA and NASA among others.

The congress brought together all sector stakeholders, offering them a unique chance to swap notes, take stock of the current situation and find out about the future trends of the small-satellite sector. As well as GMV and other sector firms, the event was also supported and co-organized by the universities of Calpoly (USA), Morehead (USA), Vigo, UPM, Barcelona, Seville, Granada and Malaga.

Miguel Ángel Molina, Contract and Commercial Manager of GMV's Space sector, took part in the discussion panel called "Commercial solutions based on Small Satellite Technologies".

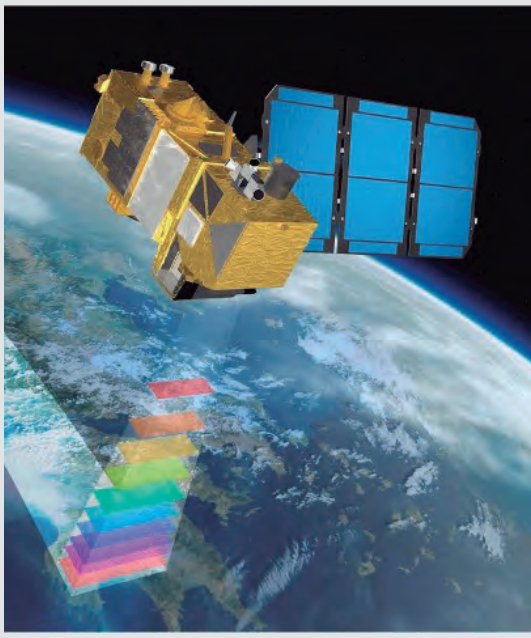
Analysis of future earth observation activities in the Atlantic region

In Jannuary GMV Team from Portugal, Spain and the UK participated actively in the ESA-organized "Atlantic from Space workshop.

The objective of this workshop was to assess the opportunities for the Atlantic region focusing on EO research and development, downstream activities and ICT evolution. The idea is then to use this new information as the basis for future ESA investments to address some of the key information needs of this important area.

These opportunities will be framed with respect to emerging Earth science, development of novel applications, testing innovative information services and implementing required capability upgrades to manage and manipulate large data volumes.

GMV participated in three papers, and Amaya Atencia, GMV Business Development Manager for Payload and Data Processing and Applications, joined in a Round Table discussing "Supporting and Strengthening Innovation Clusters in the Atlantic Region".



GMV working towards the future of the GNSS systems

The widespread takeup of GNSS (Global Navigation Satellite Systems) and the likely increase of its use in a myriad of applications like automotive and on-demand transportation is pushing the limits of navigation in harsh environments. These conditions, typical of cities and indoor environments, are still a challenge for standalone GNSS Receivers that are inherently prone to signal impairments caused by multipath and signal fading. To overcome these challenges, ESA continues entrusting GMV to push technology to new levels, through two new contracts.

In the first contract, GMV teams in Spain and in Portugal together with other key partners are developing a breadboard of the future upgrade of the current GNSS Mass Market Receivers with Galileo Open Service. GMV will implement some of the Galileo upgrades and contribute to support the assessment of their benefits in the frame of ESA G2G (Galileo Second Generation) system level studies. The key areas include Multi-constellation GNSS receivers, hybridization/fusion with sensors (e.g. IMU, terrestrial signals) and Assisted GNSS, as well as G2G Signal evolutions.

In the second contract, GMV teams in Portugal and in Spain together with other key partners accepted the challenge of processing GNSS signals at unprecedented signal levels (~10-15 dB-Hz). Different approaches will be deployed in a concept demonstrator (hardware and software) in order to assess and quantify the potential performance improvements.

GMV will implement some of the Galileo upgrades and contribute to support the assessment of their benefits in the frame of ESA G2G system level studies

GMV attends Lisbon Institute's Aerospace Week

In February Lisbon's Higher Technical Institute (*Instituto Superior Técnico*) held Aerospace Week, featuring a wide range of stands, lectures, seminars and panel discussions.

Within this event the most eagerly awaited part is the lecture cycle due to the prestige of the speakers, GMV featuring among them.

GMV representatives also took part in the chats addressing the Aerospace Engineering (AeroTéc) students, highlighting the importance of this event in offering students their first contact with the working world.

For GMV the event represented a fine chance to showcase its projects and activities while presenting future opportunities to the AeroTéc students.

PSN successfully launches its communications satellite

On 22 February, the communications satellite Nusantara Satu (previously known as PSN VI), owned by the Indonesian telecommunications operator PT Pasifik Satelit Nusantara (PSN), was successfully launched on board a Falcon 9 rocket from the SpaceX launch base in Cape Canaveral.

Built by Space System Loral (SSL) from California, Nusantara Satu will provide voice, data and broadband access services for the whole Indonesian archipelago.

GMV, under contract with SSL, provided the software, the hardware and the engineering services for the ground control system, including the ***hifly®*** real time system; the flight dynamics system based on ***focusGEO***, and also the system for the monitoring and control of the ground segment and the TT&C antennae based on ***magnet***.

The GMV systems have been installed in two control centres, a main one in Jailuhur and an ancillary one in Cikarang, both located to the east of Jakarta, on the island of Java, being owned by Indosat and PSN respectively.

This programme is the most recent of the projects in which GMV has worked with SSL in the supply of software and systems to support its satellites.

The present and future of satellite navigation

"Augment Yourself with GNSS" was the banner theme of the latest Munich Satellite Navigation Summit. GMV was one of the sponsors of this globally important event.

Munich Satellite Navigation Summit deals with satellite navigation now and in the future. It is part of the efforts of the Bavarian government and the cluster on aerospace and satellite navigation to stimulate applications and services in this high-tech field.

The Institute of Space Technology and Space Applications (ISTA) of the Universität der Bundeswehr München invited top experts from all around the world to speak about the breaking news on positioning, navigation and timing, plus the role of augmented/mixed reality as well as other advanced technologies.

The summit was held from 25 to 27 March at Munich's Alte Kongresshalle.

GMV features in the second phase of the European Commission's SRC

GMV IS PARTICIPATING IN 4 OF THE 5 PROJECTS SELECTED FOR FUNDING BY THE EUROPEAN COMMISSION IN THE SECOND PHASE OF THE SPACE ROBOTICS STRATEGIC RESEARCH CLUSTER (SRC), THE EUROPEAN COMMISSION'S BIGGEST ROBOTICS PROGRAM

On 2 and 3 April Brussels hosted the Third Peraspera Workshop, serving as a forum for presenting the results of the first phase of the European Commission's Strategic Research Cluster (SRC) on Space Robotics Technologies, its biggest space robotics program, and also for preparing the second phase.

The SRC's first activities have focused on the design, manufacture and testing of six common robotic-building blocks for space-based operations. In the last and most challenging phases of this first cluster call, these technology blocks have been tested in representative environments to serve as the basis for future orbital and planetary robotics missions . After 27 months of work GMV has pulled off important advances within the three robotics-building blocks it is leading: ERGO, ESROCOS and FACILITATORS.

The specific purpose of this new program phase is to integrate the previously prepared common technology building blocks into ground demonstrators, contributing to the development of space-robotics applications in the field of orbital and planetary use (phase 0/A studies). These robotics applications address not only the future needs of space exploration and exploitation but also potential spin-off and spill-over effects to other areas of robotic activity on Earth, such as agricultural, automotive, mining, nuclear, or underwater.

In this phase GMV is participating in 4 of the 5 projects chosen for funding by the European Commission in the second phase of the Strategic Research Cluster (SRC) on Space Robotics Technologies.

GMV will be leading the Autonomous Decision Making in Very Long Traverses (ADE) project. This project is the natural continuation of ERGO and its aim is to develop and test a rover system designed to increase data collection and perform autonomous long traverse surface exploration (with the aim of building up to 5 km). In addition to ERGO, ADE will guarantee fast reaction, mission reliability and optimal resource exploitation.

As well as leading this project, GMV will hold responsibility for all the following: upgrading ERGO and ESROCOS in EROSS, a robotic orbital support service project led by Thales Alenia Space France; Modular Spacecraft Assembly and Reconfiguration (MOSAR), a project led by the Belgian company Space Applications Services, which sets out to develop a technology demonstrator for reconfiguration of in-orbit modular satellites based on robotic capabilities; and PRO-ACT, a project coordinated by Space Applications Services to address the establishment, with the aid of mobile robots, of a precursor lunar base by using *in situ* resources; these will be essential capabilities for setting up future human settlements.

GMV will also be taking part in architecture definition, system development, integration and testing activities and bringing results to a wider audience.

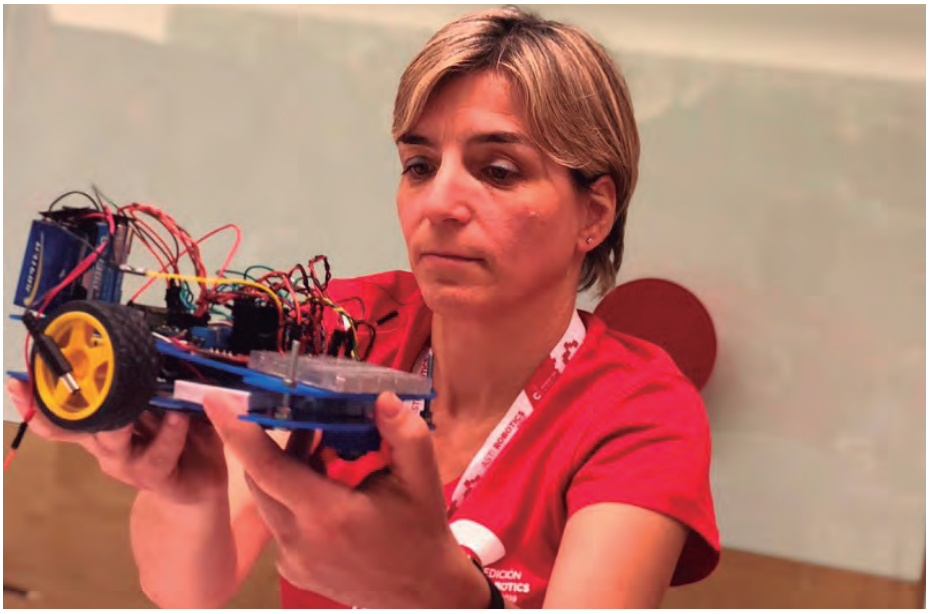
The specific purpose of this new program phase is to integrate the previously prepared common technology building blocks into ground demonstrators

GMV empowering STEM talent

GMV sponsored the third ASTI Robotics Challenge, organized by the ASTI Talent & Tech Foundation in collaboration with the Human Evolution Museum (*Museo de la Evolución Humana*: MEH,) ASTI Mobile Robotics and the charity arm (*Obra Social*) of the bank La Caixa. The venue took place in Burgos on 6 April.

The ASTI Robotics Challenge is a competition that aims to develop STEM talent and empower the upcoming generation of leaders in the collaborative mobile robotics field. Adopting the methodological approach of Project Based Learning and maker culture (Do It Yourself), the participants build a mobile robot, communicate their projects and compete in a final tournament where they have to overcome various challenges.

The teams submited their projects to a jury made up by top-level professionals in the field of innovation, technology and entrepreneurship, including Mariella Graziano, GMV's Space Segment and Robotics Director



GMV meets up in Washington with the top planetary defense experts

From April 29 to May 3rd Washington hosted the 6th IAA Planetary Defense Conference, a biennial event organized by the International Academy of Astronautics (IAA).

The IAA's threefold remit is: to foster the development of astronautics for peaceful purposes; to recognize individuals who have distinguished themselves in a branch of science or technology related to astronautics and to provide a program through which the membership can contribute to international endeavors and cooperation in the advancement of aerospace science.

This conference brings together world experts to discuss the threat to Earth posed by asteroids and comets and actions that might be taken to deflect a threatening object. As in previous conferences this year's included the holding of a hypothetical asteroid impact scenario, which could then taken as the cue for conference papers and presentations.

As well as presenting a paper on the planetary defense mission HERA, GMV also sponsored the student prize. Moreover, Mariella Graziano GMV's Space Segment and Robotics Director, chaired the lecture held under the title of "Issues Affecting Decision to Act".

Romania holds the tenth European Robotics Forum

The European Robotics Forum (ERF) is one of Europe's top robotics encounters. This tenth forum, attracting a turnout of over one thousand robotics experts, was held in Bucharest (Romania) from 20 to 22 March.

ERF2019 put on a major exhibition where companies, universities and research institutes showcased the most advanced European prototypes, products, services and projects funded under EU's Horizon 2020 research program.

Fernando Gandía, GMV's Head of Robotics (GNC/ROB)-SPS-Aerospace, took part in two presentations, one dealing with the European Space Robotics Control and Operating System (ESROCOS) and the other with the European Robotics Goal-Oriented Autonomous Controller (ERGO), two GMV-led Strategic Research Cluster (SRC) space robotics projects under the European Union's H2020 program.

GMV participates in the new Active Debris Removal projects

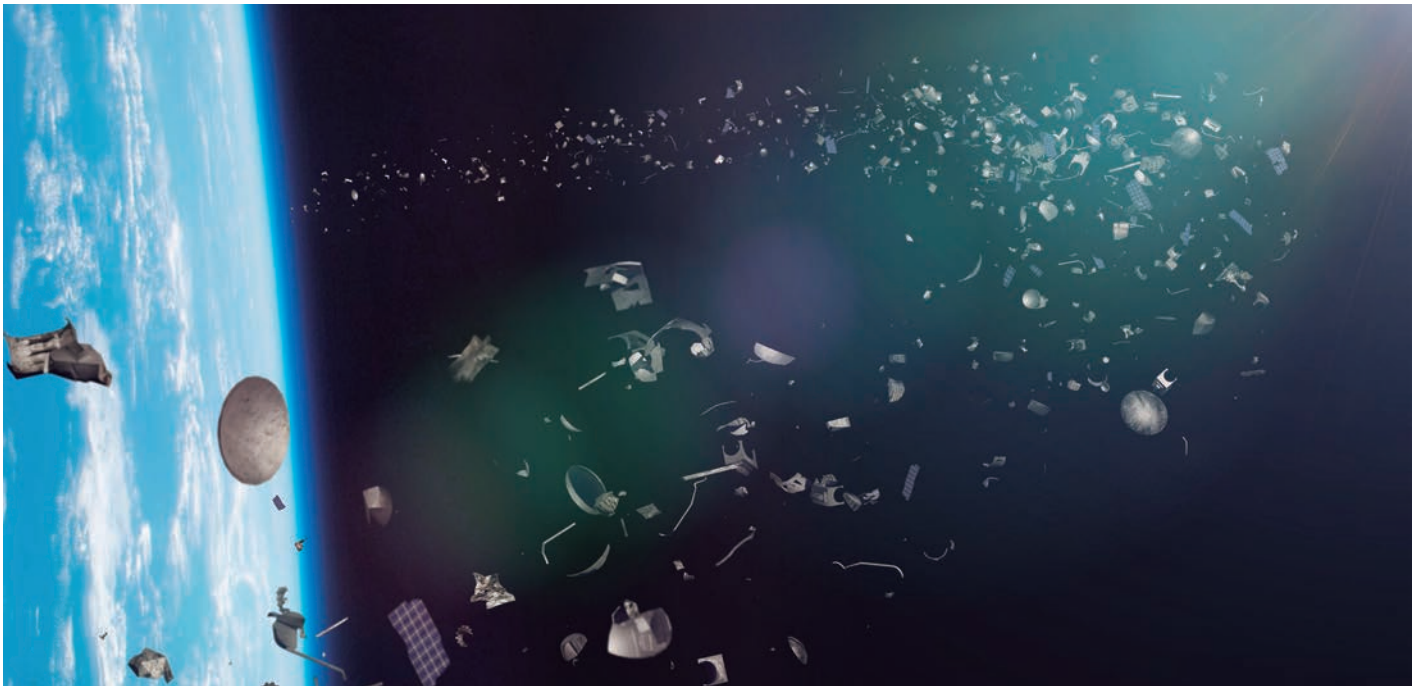
For some years now several space agencies and national bodies have been tackling the challenge of incorporating space-debris mitigation requirements into the design and development of the next generation of space missions, especially those carried out in LEO scenarios or platforms, with a substantial impact on platform design both at system and subsystem level.

One of the crucial aspects of Active Debris Removal (ADR) missions is to be able to guarantee the viability of the capture process, stabilization of the change of orbit of the end-of-life or out-of-control satellite. This means there is a clear need for fitting onboard mechanical devices to the new generation of earth observation satellites.

In an endeavor to come up with an answer to this problem, GMV is leading a consortium to carry out the European Space Agency (ESA)'s PRINCE project (Passive Mechanical and Rendezvous INterface for Capture after End-of-life).

The project, which kicked off in March, is born with the aim of producing a standard space-debris removal item fitted on Europe's future space missions. This will be done by means of the design and verification up to technology readiness level (TRL) 4 of a mechanical interface (designed and made by AVS) with integrated rendezvous / navigation supports (GMV's responsibility) that enables the capture and safe removal of a non-operational or uncooperative satellite for an uncontrolled reentry.

Within this activity the consortium will be testing an active interface including the navigation supports and conducting a demo of the complete capture process.



GMV meets its yearly appointment with UKSEDS

On 2 and 3 March the University of Edinburgh hosted the latest GMV-sponsored Annual National Student Space Conference organized by UK Students for the Exploration and Development of Space (UKSEDS).

UKSEDS (UK Students for the Exploration and Development of Space) is a society that supports and educates young students and professionals, encouraging them to pursue space exploration and research. A host of initiatives have now been organized by this society, which is the UK chapter of the global SEDS movement, the world's biggest youngster-targeted space organization operating around the world through various sister organizations in Canada, Mexico, Nepal, Spain and the United States, among others.

UK companies are now spearheading the small satellite industry, acting as experts in the supply of components and satellite systems, as well as complete solutions. After the recent announcement of the UK's first vertical launch site to be built in the county of Sutherland in northern Scotland, the conference's timing and venue were perfect for dealing with the future of space launches in the UK.

GMV chosen by EDA for application of Artificial Intelligence to Defense

UNDER THE ABIDE PROJECT GMV WILL BE APPLYING BIG DATA AND ARTIFICIAL INTELLIGENCE TECHNIQUES TO COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR) SYSTEMS, WITH THE AIM OF BOOSTING THEIR PERFORMANCE AND CAPABILITIES

The European Defence Agency (EDA) has awarded GMV the contract for conducting the study "Artificial Intelligence and Big Data for Decision Making in C4ISR – ABIDE". This project will be applying Artificial Intelligence and Big Data techniques to Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems to improve their performance and boost their capabilities.

C4ISR systems take in a wide range of architectures, IT- and communication-systems. Their aim is to glean information on the state of operations and pass it on in formatted form to the operation commanders to help them gain a clear overview and make the right decisions. They also serve as a communications platform for transmitting orders and any other information deemed relevant.

Military operations are nowadays inconceivable without systems for obtaining and working up information from several types of sensors and sources. Today, the amount of data of interest and available to be processed is increasing to amounts previously unimaginable, and the emerging disruptive technologies like Artificial Intelligence and Big Data, in combination with infrastructure and sensor technology, could help the defense community to overcome the current shortfalls of C4ISR systems in terms of performance, resilience, scalability, interoperability and efficiency. They ensure that information is quickly and reliably shuttled backwards and forwards to the troops, and enable various operation-planning strategies to be weighed up and adapted to suit the ongoing operation as it unfolds. The generated information may also be made available at different levels of complexity, according to the needs of each rung of command. An added complication is that it has to be shared among heterogeneous systems with different levels of detail and automation. This means C4ISR systems have to become increasingly smart, interoperable and adaptable to complex scenarios.

GMV is now one of Europe's leading companies in the development of Intelligence, Surveillance and Reconnaissance (ISR) software systems. At the moment it is taking part in various programs for the Spanish MoD, NATO and the European Commission. In this study GMV will be drawing on its Artificial Intelligence expertise built up in other business lines such as Cybersecurity and space and applying it to defense matters. Under this study several technological breakthroughs will be assessed and developed for networked capabilities to improve information-sharing based on wider interoperability, enhancing quality of information and providing a shared situational awareness.

This study will help out EDA Member States in all the following: identification of existing or required common specifications or standards to boost interoperability by means of innovative technologies; analysis of the current C4ISR landscape and challenges; review of C4ISR techniques in other sectors; and identification of Artificial Intelligence and Big Data techniques that could be applied to meet challenges and improve capabilities.

GMV will be drawing on its Artificial Intelligence expertise built up in other business lines such as Cybersecurity and space and applying it to defense matters

GMV a Key industrial actor in the vulnerability assessment of the external borders of the European Union

Since 2010 GMV has been the main contractor for the design, maintenance, deployment and future development of the EUROSUR Communication Network for Frontex (European Border and Coast Guard Agency). This collaboration began with a pilot project and then moved onto a fully-fledged framework contract between GMV and the Agency.

During 2018, as part of the services provided in this contract, GMV's team has designed and implemented together with Frontex the Vulnerability Assessment Data Collection Module (VA DCM), which enables it to conduct the yearly Vulnerability Assessment activities as established in REGULATION (EU) 2016/1624 for Frontex, EU member states and Schengen Associated Countries.

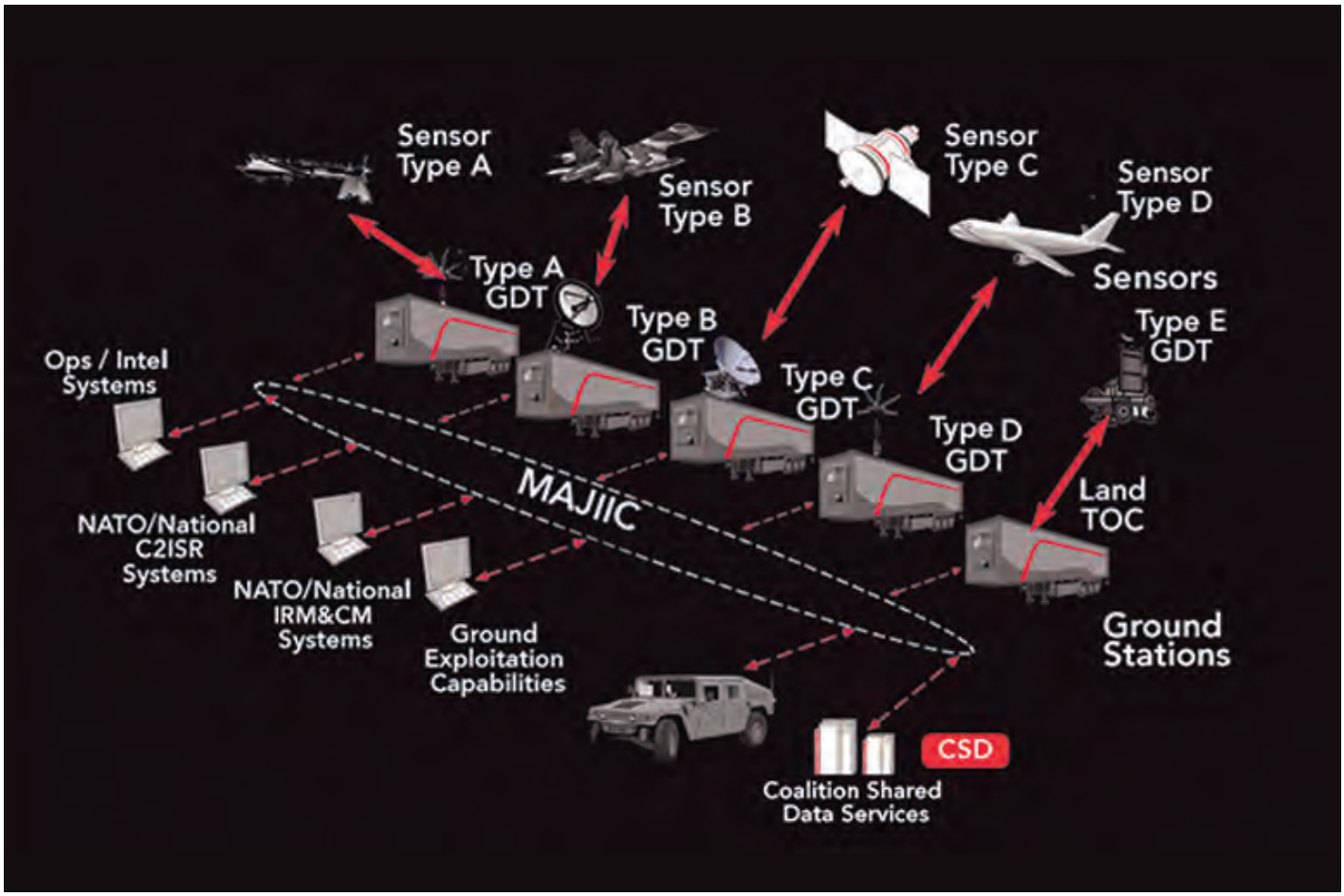
The VA DCM creates questionnaires designed by Frontex to be completed by the different member states; the answers help to break them down into the various users, roles and locations. The platform allows Frontex to identify the improvement actions required and specific support based on every member state's actual needs.

GMV has also developed and deployed in the EUROSUR Communication Network the platform for the analysis of this data retrieved from Member States and Schengen Associated Countries under the VA DCM. This analytical platform allows the information provided to Frontex by each country in the past to be browsed, explored, analyzed, reported on and reviewed along with the reports issued by Frontex.

Implementation of this Vulnerability Assessment Platform provides Frontex and member states with fast and convenient access to the predefined reports, drawing on the Business Intelligence capabilities to write their country-specific and self-defined reports that can be later shared with the Agency.

This platform is also available through the EUROSUR Communication Network making it secure and trustworthy to process EU restricted information. The upgrading of the VA ATP platform foresees enhancement of Business Intelligence capabilities, to draw up the European Border Situational Picture for the European Commission.

NATO turns to GMV technology for its new intelligence systems



The technology multinational GMV has been awarded a contract by the NATO Communications and Information Agency (NCIA) to develop the intelligence, surveillance and reconnaissance resource storage and dissemination system. The project, called Coalition Shared Data (CSD) Services, will be implemented in two phases: an interim system provided by NATO, followed by an enduring solution under this GMV contract.

CSD project has been fully funded by Luxembourg as a Voluntary National Contribution to NATO's Allied Command Operation. The contract value of the CSD Enduring Solution project is approximately 5.5 million euros.

This project upgrades the results of NATO's MAJIIC2 program (Multi-Intelligence All-Source Joint Intelligence Surveillance and Reconnaissance Interoperability Coalition) to an operational state. MAJIIC2 sets out to provide the necessary tools for maximizing the use and interchange of Intelligence, Surveillance and Reconnaissance (ISR) information. GMV is participating in the project with funding from the Directorate General of Armaments and Material (DGAM) of Spain's MoD.

CSD Enduring Solution will be integrated into NATO's system infrastructure. It targets the specification, design, development, testing, deployment and support of CSD capacity based on the MAJIIC2 program (subsequently to be standardized in STANAG 4559 Edition 4). Under this project GMV has developed a series of systems for compiling information from a host of different sources in different formats (video clips, imagery, radar, etc.), providing intelligence analysts with the necessary tools for exchanging ISR information and workflows to enable interaction in all JISR (Joint Intelligence Surveillance and Reconnaissance) phases.

This project falls under GMV's ongoing, decade-long work on JISR systems. JISR initiative synchronizes and integrates the planning and operation of all information-obtaining capacities with operation and processing capacities, plus dissemination of the resulting information to the addressee in due form and time. All this as direct support of present and future operations.

This project ushers GMV into the small fold of important NCIA contractors, further consolidating its business in the international defense and security panorama.

GMV talks about its critical-infrastructure-protection experience

On 5 March the Spanish Association of Aeronautics, Defense, Space and Security Companies (*Asociación Española de Tecnologías de Defensa, Aeronáutica y Espacio: TEDAE*), with the collaboration of Spain's National Police and the Guardia Civil, put on the International Security Conference 2019.

Held in Madrid's Security Technology Center (*Centro de Tecnologías de la Seguridad: CETSE*), the event brought together over 125 top experts from the institutions and organizations in charge of citizen security plus the most groundbreaking security and defense companies.

The welcoming address from Fernando Sánchez, manager of the National Critical Infrastructure Protection Center (*Centro Nacional de Protección de las Infraestructuras Críticas: CNPIC*) was followed by further speeches from the TEDAE president, Jaime de Rábago; the Director General of Police, Francisco Pardo Piquera; and the Principal Commissary of the National Policeforce and Advisor of the Ministry of the Interior in Spain's Standing Representation before the EU, Francisco Javier Albaladejo.

The program was rounded out by four panel discussions in which top experts from citizen-security institutions and organizations and companies debated the protection of critical infrastructure, the twofold facet of RPASs as surveillance system and threat, ,and technological security planning.

José Prieto, GMV's Manager of Business Development and Institutional Relations – Defense and Security, took part in the discussion panel dealing with the protection of critical infrastructure, highlighting industry's role through public-private cooperation and the importance of R&D activities in this field.

GMV features in OFICAEX days in support of EU and NATO defense industry

On 23 and 24 January, in Brussels, the Directorate General of Armaments and Material (*Dirección General de Armamento y Material: DGAM*) put on a conference called Industry Days in the EU and NATO, doing so in collaboration with the Permanent Representation to NATO in Brussels (REPER NATO), the Permanent Representation to the European Union (REPER EU) and the Military Representation (MILREP) to NATO and the European Union.

The first of these days, in support of the EU, held on 23 January, was opened by the ambassador Juan Aristegui, Lieutenant General Juan Montenegro (MILREP) and Major General Felipe de la Plaza from DGAM's Subdirectorate of International Relations (SDG-REINT). A small number of Spanish firms also took part on this day, restricted to those with proven experience in European defense programs. José Prieto, GMV's Manager of Development and Institutional Relations-Defense and Security, gave a presentation of GMV's activities in this sector and also talked about GMV's experience in initiatives of the Preparatory Action on Defence Research (PADR).

Industry Day at NATO, held on the 24th, featured presentations of the capabilities of a larger group of Spanish sector firms, chosen by the Foreign Support Office (*Oficina de Apoyo Exterior*: OFICAEX) as the best representatives of the capabilities of Spain's defense industry as a contribution to EU and NATO's security and defense programs. Forming part of the industrial bloc, GMV talked about its own experience and the lessons learnt in the various programs it has taken part in, such as the project currently being carried out for NATO, CSD Enduring Solution, which aims to maximize the use and interchange of information on intelligence, surveillance and reconnaissance resources between NATO members.

With the aid of OFICAEX, DGAM has managed to establish these Days as a showcase of Spain's defense industry and an excellent way of developing one of its main objectives, namely institutional support of the internationalization of Spain's defense industry (AI3DE).

Opinion

The value of proper support

Creating something, getting a system or product up and running and even improving something that already exists are activities anyone can justifiably feel proud of. But that's not the end of the story. Any creation needs to be maintained afterwards, looked after and checked constantly or at least periodically to ensure the created value lasts as long as necessary. Proper support is no bagatelle and it is well worthwhile looking at the difficulties involved and how the cost might reasonably be calculated. The aim of this article is to shed some light on this matter.

It is obvious that good support is a key element in customer satisfaction and hence in our ability to retain this clientele and broaden our range. Each incident that crops up is a chance to show our company's commitment and efficiency. A client is quite often happier with the service after an incident well dealt with than if it had never occurred at all.

Nonetheless, organizing a service of this type poses many difficulties that are not always visible to the client.
From the organizational point of view it is essential to have teams working on a shift basis, during the night, at weekends and even on public holidays. This raises particular difficulties in terms of managing this personnel properly. Any absenteeism and rotation will have a much bigger impact than in other activities.

It is also very hard to keep the team trained and informed of the situation of each project. It's not enough just to have experts on every subject; it's essential for someone with proper knowledge of each service-rendering technology or system to be on hand in any time interval.

Resource planning is no bagatelle either. Although forecasts can be made, a good part of the work crops up randomly. There might therefore be a succession of low-demand periods with little work and other moments with a buildup of requests and incidents, at which times available personnel might be hard put to deal with everything thrown at them.

Clearly there has to be a set of proper tools, up-to-date documentation and clear working procedures to facilitate this work. Creating all this and keeping it in a perfect state is essential but no means easy. The ideal situation would be a uniform and consistent system for all clients and services. This is not always possible. On some occasions the client or service calls for something special and exceptions therefore become inevitable. Basically, the right balance therefore needs to be struck between homogenization to cut costs and managing fine detail to achieve excellence.

Manager of the Managed Services Division of GMV's Secure e-Solutions sector

GMV collaborates with URJC's Master's Degree "Data, Complex Networks and Cybersecurity Sciences"

The shortage of skilled Cybersecurity personnel is becoming one of the main barriers to growth in the business world.

In response to this problem GMV has decided to collaborate in the initiative launched by the DCNC Sciences Institute of the Universidad Rey Juan Carlos (URJC): a Master's Degree called "Master Data, Complex Networks and Cybersecurity Sciences", which aims to give continuity and a high degree of specialization to Cybersecurity training.

The new risks flag up Cybersecurity as industry's top priority

The Cybersecurity Group of the Spanish Association of Aeronautics, Defense, Space and Security Companies (*Asociación Española de Tecnologías de Defensa, Aeronáutica y Espacio*: TEDAE) has put on its second one-day Cybersecurity Conference to address the various security issues in our industrial environments. These include the importance of public-private integration in the Cybersecurity field; the need of being proactive and stealing a march on hackers and the obligation of raising awareness of risk situations in carrying out digital transformation initiatives.

Ricardo Sáenz, Manager of GMV's Defense and Security Programs, chaired the debate on "Intelligence and Secure Technology Certification", which stressed the importance of compiling data for subsequent analysis to head off any events that might occur in the future, directly impacting on business continuity. Ricardo's conclusions underlined the need for Spanish industry and government authorities to take an upfront role in the European Commission's Cybersecurity and Cyberdefense initiatives.

Another aspect that came under the spotlight, with the participation of Miguel Hormigo, GMV's Industry Sector Manager, was "IT/OT Convergence in Industrial Cybersecurity". This convergence is driven mainly by operational-efficiency and cost-cutting motives, with Cybersecurity all too often being tagged on as an afterthought. In this scenario the IT world has been tussling with cyber risks for many years, whereas the OT world is starting much further back. Despite this, the truth is that digital transformation initiatives are speeding up this integration and helping to spread further afield a true awareness of the importance of Cybersecurity.

Hormigo argued that proper knowledge of the scope, importance and potential advantages is vital when tackling IT/OT convergence in processes, products and services. One of the most important protection measures is across-the-board planning, increasing the awareness and training level of all involved actors. It is also essential to carry out a sound system of continuous improvement and to bring in concrete measures, including prevention-, surveillance- and continuity-items and even cryptography solutions wherever necessary.

GMV wins a Cybersecurity prize for its work on the Galileo project

GMV has won one of the SIC 2019 prizes for its expert Cybersecurity work in the contract for maintenance and upgrading of Galileo's Ground Control Segment (GCS), awarded by the European Space Agency in 2018 to a GMV-primed consortium. Within this project, the Cybersecurity aspects, led and developed by GMV, feature prominently.

The prize was picked up on 24 April by Luis Fernando Álvarez-Gascón, General Manager of GMV's Secure e-Solutions sector, during Securmática's 30th anniversary celebrations. During his thankyou speech Luis Fernando explained this success as the result of decades of hard work, a 35-year track record in which the European Space Agency has turned time and time again to GMV's proven expertise in innovation, business development and internationalization. These strengths have all helped to win the firm worldwide leadership in telecommunication satellite control centers and satellite navigation systems. These factors, combined with GMV's 25 years of experience in the Cybersecurity world, have been key in achieving this groundbreaking contract.

The executive stressed the importance of this contract award not only for GMV but also for Spain itself, because it was by no means a sure thing that a university spinoff would successfully manage to turn itself into the industrial leader of a critical project at European level. "*This contract award is the result of GMV's proven expertise but it is also owing to political support of innovation, talent, entrepreneurship and internationalization, and we now need a new wave of similar public support for the national Cybersecurity industry. We face an unmissable chance to be stakeholders in this digital transformation instead of mere onlookers*".

One part of the contract consists in providing a set of Cybersecurity services including security engineering, secure development, vulnerability management, accreditation and implementation of an audit program, among other features. Juan Ramón Coz ESA's GNSS Cyber Internal Auditor, and Juan Antonio Abánades, Manager of GMV's GCS Security Sector, gave a congress lecture setting out the Cybersecurity challenges in the critical environment of Galileo's ground control segment. The Cybersecurity experts explained how auditors will have to tackle such challenges as planning, and sketched out some of the lessons learned during the Cybersecurity audit of major systems and public programs, with large budgets and in critical, high-security environments.

GMV invited by UPV to give its view of privacy

Every time we register for any internet service we sign a seldom-read contract giving permission for our digital identity to be supervised and analyzed, handing over our data and allowing it to be used practically without constraint. The problem is obvious. We accept certain services without taking into account the use of our personal data or, what comes to the same thing, without asking ourselves where this data is being stored, who has access to it and what it will be used for.

To look at this problem the Polytechnic University of Valencia (Universitat Politècnica de València: UPV) has put on a conference focusing on privacy, data protection and Cybersecurity. Two top experts in this matter took part in this event, namely Ricard Martínez, Director of UPV's Digital Transformation and Privacy Chair, and Carlos Sahuquillo, GMV's Cybersecurity Consultant. Both agreed on the crucial importance of design-up data protection without waiting for a vulnerability or legal breach to rear its head before taking appropriate measures.

Sahuquillo explained what Blockchain is and how a digital identity network could be created with this technology to access all the services that need our data without necessarily needing to sign up first. This would involve a sort of shared digital-data repository based on Blockchain technology, so we could then ensure the traceability, integrity and confidentiality of all stored data.

How to protect against insider threats?

Threats don't come only from outside. One study estimates that almost 40% of IT security breaches are perpetrated by insiders. Some reports claim that over 50% of enterprises have suffered an insider attack in the last 12 months, while 90% declare themselves to feel vulnerable to insider attacks. Why do these attacks occur? In general to make an immediate profit but sometimes too for motives of revenge or future profit, such as carrying off data to a new job.

In April IT Digital Media brought together Cybersecurity experts to debate insider threats, which are becoming increasingly common and costly. Javier Osuna, GMV's Manager of Cybersecurity Services and Consultancy Division, spoke about his experience and gave his opinion on insider threats, stressing that digital transformation processes are inevitably blurring the physical and logical limits. Aspects such as time to market, mobility, telework, the association and subcontracting of firms and individuals have opened up the field and lengthened the value- and supply-chains. As a result insider threats are now becoming an increasing peril, calling for a raising of awareness and a rethink in line with borderless protection.

When dealing with such a broad-ranging concept as insider threats, Javier Osuna argued that we should focus on the perpetrators and their motives. Who are the insiders and what are they after?.

The insider is the essential link of a "dark chain" of information supplies, necessary for other purposes driven by various motives (political, economic, social, criminal, etc.). Their hazardousness resides in the insider's trusted position and ease of access to sensitive systems or information without triggering alarms. This is a complex scenario in which authorized persons are those who access the sensitive information, the destination of that information then determining whether or not an incident ensues.

The motives are diverse, such as hacktivism or organized crime, industrial espionage or even inter-country spying and finally the inadvertent result of careless or less conscientious workers, or sometimes even victims of extortion. GMV keeps a continuous watch on all these modus operandi to ensure secure use of IT recourses and all information handled by any organization, developing use models (each organization has its own use cases), to weigh up the danger of misuse of sensitive information, its ease of access or visualization and requirements for its distribution. This enables us to break down any information-leaking incidents into various types, ranging from monitoring of any activity with the organization's data, giving advice on a "Forensic Readiness" basis to build up investigation skills against incidents of this type and finally establishing warnings of information misuse.

Oporto brings together the top Cybersecurity stakeholders

On 3 April IDC Portugal, together with some of the key industry players including GMV, held the IDC Porto International Cibersecurity Conference 2019, at Sheraton Hotel, Porto, Portugal.

The event covered the key-topics concerning Cybersecurity, cyberattacks, data breaches, new security challenges and security posture. The role and nature of enterprise security is changing and digital transformation is disrupting the IT environment as never before, while the threat landscape continues to evolve and regulatory reform piles pressure on scarse security resources. However, new security approaches to these core challenges are now emerging, and security leader and teams must rethink their value proposition in order to turn these new opportunities to good account.

GMV was one of the sponsors of this conference, which introduced the security solutions and approaches that can help to demonstrate the security-enabled business outcomes, driving business buy-ins and even advocacy.

The Provincial Hospital of Castellón spearheads the personalization of oncology therapy

THE HOSPITAL OF CASTELLÓN HAS TAKEN UP ***radiance™***, GMV'S EXCLUSIVE-SIMULATION SYSTEM, FOR PLANNING OF INTRAOPERATIVE RADIATION THERAPY (IORT). CARLOS FERRER, MANAGER OF THE ONCOLOGY INSTITUTE OF THE HOSPITAL CONSORTIUM OF CASTELLÓN, AND JUAN LÓPEZ TARAJUELO, HOSPITAL RADIATION PHYSICIST, TELL US ABOUT THE BENEFITS OF THIS TECHNIQUE AND ITS APPLICATION WITH ***radiance™***

In late 2009 the Provincial Hospital of Castellón began to carry out research into patients suffering from rectal and breast tumors and others who had suffered pelvic or abdominal relapses of irreversible digestive or gynecological tumors, applying intraoperative radiation therapy (IORT). For over two years the hospital worked to establish a protocol on surgery for tumors of this type, planning it with the aid of the GMV-designed software, ***radiance™***. The first results were then presented in the Latin American Congress of Medical Physics. Carlos Ferrer, manager of the Oncology Institute of the Hospital Consortium of Castellón and current President of the Spanish Radiotherapy Oncology Society (*Sociedad Española de Oncología Radioterápica*: SEOR), confirmed that "*there is a 70 to 80% match between planning and actual surgery using this virtual system*". The added value of ***radiance™*** resides in the fact that "*it cuts out the guesswork*".

Fast forward ten years, and ***radiance™*** has already released its 4th version, and the Castellón hospital now forms part of a select club of world-level referral hospitals using the exclusive simulation tool for planning application of intraoperative radiotherapy. Doctor Ferrer laid stress on its added value because "*in tumors of a certain complexity it enables surgeons to act directly on the surgical site, showing up resection-resistant areas in order to facilitate toxicity-minimizing application of the treatment*". In locally advanced tumors, such as T4 rectal cancer with involvement of surrounding organs, "*the mere idea of surgical treatment without techniques of this type is unthinkable. These techniques, after all, enable treatment to be applied in a way that eliminates microscopic residue on which external radiotherapy is incapable of acting. Sandwich-type treatment, combining pre-surgery external radiotherapy with intraoperative radiotherapy gives us greater efficiency with advanced tumors*".

Doctor Virginia Morillo takes up the story. She stresses how use of the planner "*enables us to ascertain the real coverage of the tumor before going*

into the operating theater and also the actual radiation dose that will spill over onto surrounding tumors. We can hence gauge the knock-on toxicity risk; this is crucial when dealing with very high radiation doses".

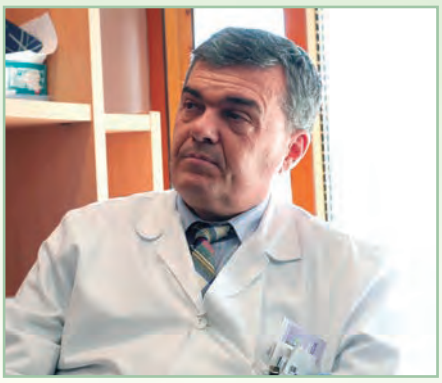
As well as the Provincial Hospital of Castellón this select club also includes, among others, the University Hospital of Mannheim (Germany), dependent on Heidelberg University and a worldwide leading light in intraoperative radiotherapy; the Hospital Doctor Negrín (Las Palmas, Spain); University Cancer Institute of Toulouse Oncopole (France); Weill Cornell Medical College (New York, USA); the European Institute of Oncology (Milan, Italy) and Loyola Medical Center (Chicago, USA). With all of these GMV has signed collaboration agreements under which ***radiance™*** is progressively extending its reach to more types of tumors, in response to the requirements of users: hospital radio physicians and radiation oncologists.

COMMITMENT AND A PROFESSIONAL APPROACH

There are some tumors that can only be partially removed or resected, always leaving behind some cancer cells and others that cannot be removed at all (non-resectable); there are yet others that, albeit resected, pose a high illness-recurrence risk in the surgical site. For all these cases, as Ferrer explains, IORT comes across as the only life-prolonging option. Even so, "*Italy, for example has 55 IORT-equipped hospitals treating between 5-6% of oncology patients (about 8% of those referred for radiation therapy) whereas Spain has only 8 IORT-equipped hospitals, meaning that less than 1% of cases can be treated with IORT. This shows there are many cases where IORT would be beneficial but cannot be used due to lack of infrastructure*". To turn this situation around, the specialist has been working from his hospital and also from SEOR to get across the huge therapeutic benefits of IORT.

Take the following as an example. Even when IORT is applied during surgery itself, it is usual after removal of the tumor to apply IORT with small devices called linear accelerators in the operating theater. These miniaturized applicators, available only in a small set of hospitals, come into their own when the old, large-scale equipment, no longer works. Castellón Hospital does not have any miniaturized linear accelerators but it does run an oncology service whose patient commitment drives it to apply IORT even with large-scale linear accelerators; this calls for a big and merit-worthy coordination effort to take the patient from the operating theater to the radiation bunker in the cellar. So professional is its team, that it manages to match the results obtained by any other leading center in treatment of this type using cutting-edge equipment. A new operating theater soon to be opened on the same floor as the accelerator will greatly simplify the conditions for surgery of this type and turn it into a benchmark hospital in Spain.

THE EXPERT'S OPINION



DOCTOR CARLOS FERRER

Manager of the Oncology Institute of the Hospital Consortium of Castellón and President of the Spanish Radiation Oncology Society (Sociedad Española de Oncología Radioterápica: SEOR)

What is the degree of IORT takeup in Spain?

Spain's low level of investment in radiotherapy in general means the takeup has fallen behind the rate in other countries. Indeed, rather than public investment, it was a donation from a private foundation that drove a significant renewal of equipment, including various items of intraoperative radiotherapy equipment to facilitate treatment that would otherwise be impossible with conventional therapy. This means more advanced tumor rescue surgery can be used or replacement breast irradiation techniques that are very economically and socially cost-effective.

As for the general takeup of intraoperative radiation therapy, there is a problem of the global assessment of this technique as a fundamental cancer therapy technique. It is a very cost-effective and efficient therapy in comparison to pharmacological treatment due to various factors such as a patchy availability of this equipment nationwide. Governments need to realize that system sustainability will be favored by a strong and efficient radiotherapy system.

What are some of the benefits of IORT applied with *radiance™*?

As I've already said, there are some tumors in which it makes absolutely no sense to go into surgery without techniques of this type. At the moment many patients receive only fragmented radiotherapy treatment involving many separate hospital visits. This imposes an additional cost beyond the economic, in terms of the upset to their quality of life. IORT would reduce all this piecemeal treatment to a single dose administered in the operating theater. Any advanced society is duty bound to look after all aspects of the oncology patient's quality of life.

A sine qua non of applying radiotherapy nowadays is a planner capable of detecting possible radiation under- or over-doses.

JUAN LÓPEZ TARAJUELO

Hospital Radiation Physicist

What is the hospital radiation physicist's IORT role?

We see to the application of patient-care techniques based on physical principles. One of our main concerns is to ensure that the IORT dose prescribed by oncologists is actually given with the greatest possible accuracy. This involves controlling the radiotherapy beam administering machines and using tools to measure the amount of radiation absorbed by the patient's tissues, a task in which ***radiance™*** ensures precise analyses.

This planner needs some initial readings, provided by the radiation physicists, from the accelerators' radiation beam. On the basis of these readings its "internal motor" can then calculate the absorbed dose. The treatment is then personalized in combination with an imaging study, in collaboration with the oncologists. The crucial input of ***radiance™***, as an intraoperative radiotherapy planner used jointly with the external radiotherapy planners, is that it allows the aggregate dose to be assessed, thus estimating the effects of the treatment as a whole. Its calculations combine two algorithms, one classic and another one that enables difficult situations to be tackled such as irregularities or cavities. Its introduction therefore represents a clear breakthrough in this treatment.

GMV gives its point of view on the advantages of online patient recruitment at Inforsalud

GMV participated for yet another year in the benchmark Healthcare and ICTs event, Inforsalud. The company ran a stand showcasing its healthcare range, and its specialist in Smart Health and Healthcare Data Evidence solutions, Adrián Rodrigo Salas, gave a paper entitled "Online health-research recruitment strategies".

In a panel discussion chaired by Carlos Gallego Pérez, Head of Medical Imaging Systems of the Healthcare Department of the Regional Authority of Catalunya, Rodrigo explained the company's online patient recruitment strategies under the MOPEAD project.

He also explained how the Big Data platform developed by GMV in this project "*allows healthcare personnel to draw evidence from the data uploaded into it. This platform prepares the data for the data-analysis and clinical-personnel teams to combine their experience and training on given pathologies in search for clinical evidence and significant, tried-and-tested information*".

The GMV specialist explained the advantages of online recruitment over traditional techniques. "*As technology continues to advance and the online world becomes part of our everyday experience, channels of this type carry ever higher traffic; they are now where users share or search for information on a healthy lifestyle, specific information on pathologies, prevention, treatment and therapies, etc.*"

Providing they work within a proper regulatory framework and ethical control, as Adrián Rodrigo pointed out, "*these strategies tap into the full potential of online channels, giving the general public a closer idea of clinical research and allowing them to participate in it. This controls and cuts the recruitment outlay and gives access to a much bigger trawl than traditional methods*".

IntraOp and GMV join forces in the fight against cancer

In April GMV's Tres Cantos headquarters hosted a working meeting between GMV and its partner for the worldwide distribution of ***radiance™*** for electron-beam IORT users, IntraOp Medical Corporation.

Sebastian Adamczyk, IntraOp's Clinical Science and Technology Manager, attended a presentation in which Carlos Illana, Head of the ***radiance™*** Product, Juan Carlos Llorente, GMV's ITER/Robotics business development manager, and Javier Zubieta, Marketing and Communication Manager of GMV's Secure e-Solutions sector, presented the company's latest breakthroughs in various fields such as healthcare, robotics and Cybersecurity.

Adamczyk was also told about the GMV's latest surgical navigation developments capable of being embedded in IntraOp's electron-beam IORT linear accelerators.

This meeting coincided with the first anniversary of the contract signed between both leading companies to make further headway in IORT application. IntraOp® Mobetron® is the world's only portable, self-shielded linear accelerator capable of providing electron-beam IORT in the operating room, bringing together the work of surgeons and radiation oncologists. GMV's ***radiance™***, for its part, is the world's only IORT planner of its type.

antari, features in Capital Radio's World Health Day

Ageing-driven chronicity has now been addressed by the World Health Organization, which has drawn up an Action Plan on Ageing and Health to reduce the population actually or potentially affected by non-communicable or chronic diseases.

Chronicity is a health-system-modifying factor, generating structural changes, and technology is a strategically important enabling factor of upcoming changes to confront this problem. This was the theme of Capital Radio's discussion "Chronicity, ageing and dependency" with GMV's participation.

Some of the issues dealt with by Javier Téllez, GMV's health solutions specialist, were the results gleaned by the telemedicine platform ***antari*** in the monitoring of chronic patients, frail and pre-frail persons, as part of the FACET project led by Doctor Leocadio Rodríguez Mañas, head of the Geriatrics Service of the Hospital Universitario de Getafe and its research institute, and the sensor-based forecasting of possible exacerbations of chronic obstructive pulmonary disease (COPD).

The monitoring of chronic patients and the elderly could significantly cut down the number of hospital admissions, while also heading off health impairment risks. "*There is evidence of the ability of sensors to detect a COPD exacerbation up to 72 hours beforehand by recording a change in patient activity*", pointed out Téllez. "*If we bear in mind that the daily hospital cost amounts to 2000 euros the benefits of this patient monitoring technology speak for themselves*".

Similarly, low-cost sensors such as those used in FACET enable the specialist to monitor the elderly person's activity without the person having to interact with the technology. Because, as Rodríguez Mañas insists, in line with the FACET approach "*the patient is assessed in terms of activity not illness. The geriatrician calls for an "urgent change in the elderly-treatment approach viewing them from the perspective of function rather than illness. Because in over-80s, eighty percent of the death risk is accounted for by age and gender, 12% by function and only 0.7% by the illness*".

Warsaw hosts the 4th International Public Transport Fair

From 13 to 15 March the PTAK WARSAW EXPO and Congress Center in Warsaw (Poland) hosted Warsaw Bus Expo, the International Public Transport Fair. Held this year for the fourth time, it brought together the top spokespersons of the transport industry, bus manufacturers, operators, carriers, plus representatives of local governments and the cooperating IT industry.

At the fair, GMV displayed its latest breakthroughs in public intelligent transportation systems. The company also presented a range of products that enable public transport systems to offer more comprehensive services, such as electronic fare-collection systems, its inhouse ***GMV planner*** solution and the telematic video-surveillance CCTV system, among others.

The program also included a series of lectures and chats on the industry and the most groundbreaking transport projects now underway. The various discussion panels dealt with such matters as railway transport, transport ergonomics and ecology, the latest logistics technologies and the future prospects for public transport.

GMV's participation in this tradefair showcases its ongoing work in the design, development, implementation and rollout of its intelligent transportation systems (ITS) based on IoT, mobile communications and GNSS.

GMV modernizes Rabat's urban transport

ALSA AND CITYBUS TRANSPORT TURN TO GMV FOR THE SUPPLY OF THE ELECTRONIC FARE-COLLECTION, FLEET-MANAGEMENT AND PASSENGER-INFORMATION SYSTEMS OF THE MOROCCAN CAPITAL CITY'S URBAN TRANSPORT

The passenger transport company ALSA, in a joint venture with the local firm CITYBUS TRANSPORT, has been awarded the concession for running Rabat's urban transport service, with an initial 350-vehicle fleet to be enlarged to 500 in the coming years. It then selected GMV for supplying the fare-collection, fleet-management and passenger-information systems in the Moroccan capital city.

The onboard equipment is based on ***ETC-606i-8*** ticket vending machines, which, fitted with a GPS receiver and built-in communications modem, also cater for validation of contactless cards.

The fleet-management control center will tap into vehicle positioning information to run the service; the movement of the whole fleet is displayed on GIS screens with text-message driver communication.

Calculation of the bus-stop passing times, managed by the control center itself, will be sent on to the bus-stop information panels, with automatic adjustment indications also being sent to drivers who are running late or early.

ALSA has developed applications and system-integrating devices to obtain necessary information. These will then be drawn on to furnish passengers with web applications and Smartphone APPs for card recharging, checking their remaining travel credits and recent movements. Users will also be told about the bus-stop passing times, timetables and line routes.

The system also comprises 120 LED-type panels giving information on passing times at the main stops. Inspectors will be issued with 30 handhelds enabling them to check on any fraudulent passengers and hand out fines.

As for the ticket recharging network, this allows not only web- or APP-based recharging but also onboard recharging. Two automatic ticket-supply and -recharging machines will be installed in the city's two main stations, with another 20 attended recharging posts distributed throughout the city.

Under the project users will be furnished with Smartphone APPs and web applications for online card recharging and check of transactions and remaining travel credits

Avanza and GMV renew ITS systems in Marbella and Segovia

Grupo Avanza has once more turned to GMV to supply the fleet control systems of its recently awarded urban transport concessions, Urbanos de Segovia and Urbanos de Marbella, to be run by two Grupo Avanza companies under a 10-year concession.

This new activity further cements GMV's presence in the various business lines of Grupo Avanza, building on its past business in urban and interurban transport and long haul.

In Segovia the project awarded by Avanza to GMV includes setting up an advanced fleet management system and passenger information system plus an onboard video-surveillance (CCTV) system.

As for Urbanos de Marbella, the abovementioned systems are fleshed out with an ecodriving system and ridership counting system based on time-of-flight" technology, which guarantees accuracy of almost 98%.

The supplied fleet management system continues along the lines of systems previously supplied to Grupo Avanza, meaning that even more of the group's fleets are now running with this system. The projects are rounded out by a new version of the CCTV system, not previously fitted in Grupo Avanza.

As for the passenger-information system, it offers not only the basic functions of helpful passenger information and multimedia information on points of interest, but also the additional option of safety videos shown to the driver on demand. This new video function, rather than just still images, is an upgrade on the passenger-information systems previously supplied to the group.

Both systems are also synchronized with bus-stop information panels, with a new supply of 15 units and integration of existing ones. In the case of Urbanos de Marbella, the local council, notably, has undertaken to equip the city with 89 information panels over the next 10 years.

The recent opening of the new concessions means that both projects have had to meet really tight deadlines to ensure compliance with the commitments entered into with the local councils.

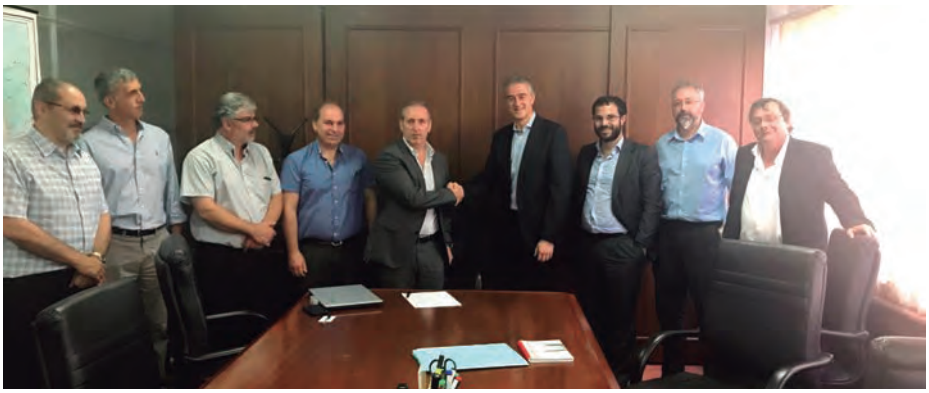
Montevideo once more turns to GMV for modernization of public transport

For over 10 years now GMV has been providing the Intendencia Municipal de Montevideo, the local transport authority, as well as the main urban and metropolitan public transport operators, with its inhouse advanced fare collection and onboard prepayment technology.

Montevideo's various public-transport stakeholders have once more turned to GMV for modernizing both the software and hardware of their ticketing systems.

Under Montevideo's new public-transport system GMV is phasing in several new software functions; the most notable are the new keyboard-configuration options for the onboard ticketing machines and automatic control of outside information panels from the ticketing machines.

Additionally, the main public-transport operators of the metropolitan area of Montevideo continue to place their trust in GMV for technological renewal of onboard fare-collection systems. Recently, various representatives of Montevideo's Metropolitan Transport System visited GMV's Ticketing Systems Excellence Center in Barcelona to forge even closer technological bonds and find out about the latest technological breakthroughs being developed by GMV in fare collection and prepayment. These include direct EMV bankcard payment on onboard ticketing machines and the ***deepsy®*** developers' platform, allowing third parties to develop their own fare software to work on GMV equipment.



As of now over 1000 vehicles belonging to five different operators within Montevideo's Metropolitan Transport System have been fitted with GMV's fare collection equipment, including ticketing machines onboard each of these 1000+ vehicles, plus the necessary software for operating within the Metropolitan Transport System's business rules.

GMV to supply the new video-surveillance system for Seville's bus fleet

TUSSAM TURNS TO GMV FOR ROLLOUT OF THE NEW ONBOARD VIDEO-SURVEILLANCE SYSTEM FOR ITS 410-BUS FLEET. THE SYSTEM IS BASED ON INHOUSE, TOP-QUALITY DIGITAL RECORDING EQUIPMENT

The technology multinational GMV has won the tender for supply, installation and maintenance of an onboard video-surveillance system on TUSSAM's 410-bus fleet.

The goal of GMV's new solution will be to boost security on the strength of internal surveillance onboard the buses. Its functions will accordingly include recording of the video signal from all bus cameras and wireless downloading of this information to the control center, which can then display and work with all videos.

The new onboard digital equipment supplied by GMV under this new contract will include video recorders, IP cameras, PoE switches, ridership counters and communication routers, plus the video-surveillance system to be displayed and worked with in the control center. The latter will involve software that allows the control center operator to display images from all the various cameras in real time, look for recordings and play them in various screen configurations as well as configuring the main system parameters.

The core of GMV's video-surveillance system comprises its own inhouse digital recording equipment, which is compliant with the most advanced road- and railway-certifications, ensures ONVIF compatibility and is capable of making high-quality Full HD image recordings.

This project cements GMV's position as a leading supplier of onboard video-surveillance solutions in intelligent transportation systems in 2019, after also winning notable contracts for other national railway operators such as Metro de Barcelona (TMB), Metro de Sevilla, Euskotren and FGV or road transport operators such as Consorcio de Transportes de Mallorca, involving the supply of a complete CCTV system for the Balearic Islands' whole 611-bus fleet.

First maintenance contract for the ITS system in Bydgoszcz

At the beginning of the year GMV signed the new maintenance contract with Bydgoszcz Transport Authority, ZDMiKP. This new contract concerned an additional year of maintenance of the Intelligent Transport System together with an additional contract for maintenance of 125 passenger information displays. The new agreement covers all technical customer support and maintenance of the system and the equipment installed in the 300 vehicles.

The scope of the contract includes also a set of development hours for introducing modifications and improvements in the system. The ordering party intends to use this package to develop the Passenger Information module for mobile devices and to introduce applications for Android and iOS.

The mobile application will allow passengers to check the arrival times of trams and buses at a chosen bus stop, see the position of the vehicle on the map, plan the trip by means of Google Transit engine, check points of interests such as museums, monuments, theaters and many more.

Cooperation between GMV and Bydgoszcz Transport Authority started in 2012, when GMV won a contract for delivery of an ITS System designed for passengers and public transport management; these systems have now been up and running for several years. Onboard computers with a GPS locator, supplied by GMV, were installed in Bydgoszcz's public transport buses and trams as early as 2012. The driver's cockpit login system makes it possible to estimate the arrival of buses at bus stops, of which residents of Bydgoszcz are informed via electronic passenger information panels and the dedicated website. Data from the system, processed by fleet managers, is also used to improve the punctuality of the entire bus network - which is beneficial for all users of public transport. Since that time GMV has been successfully providing ZDMiKP with further services.

GMV introduces its latest railway technologies in Asia Pacific Rail

On 19 and 20 March GMV took part in Asia Pacific Rail 2019, a yearly Hong Kong technology fair that is one of the leading railway-sector business events in the Pacific region and beyond.

With 40,000+ kilometers of rail projects either planned or under construction, Asia Pacific is probably the most exciting rail market in the world. Countries like Indonesia, Thailand, Philippines, Malaysia and Myanmar are busily developing their railway infrastructure and updating their technologies in order to cope with their growing economies and populations.

The event was a big success and was attended by movers and shakers of Asia's rail sector; it featured more than 100 exhibitors and more than 2000 attendees from all over Asia. Many seminars and conferences were also held, dealing with hot topics like urban mobility, signaling and communications, asset management, passenger experience, operations and maintenance, ticketing and payments, and so on. GMV displayed its whole array of solutions for the railway sector, such as its advanced fleet-management, electronic ticketing solutions, planning and scheduling software and onboard solutions (passenger information, video surveillance and public address).

The exhibition was a great opportunity for GMV to raise its profile even further in the ASEAN rail industry, meet the management of different train operating companies, as well as a public transport authorities, and show potential customers how GMV can improve their transport systems.

GMV wins a CSZKM system maintenance contract in Szczecin

In March GMV signed a contract for support and maintenance of the advanced fleet-management system for the public transport of the Road and Public Transport Authority in Szczecin (*Zarząd Dróg i Transportu Miejskiego w Szczecinie*, ZDiTM)

The contract will cover the devices and software supplied by GMV to Szczecin since 2011. The subject of the contract is the provision of post-warranty services for the equipment and the development of the central software.

GMV will be responsible for day-to-day maintenance and inspections of the devices, maintenance of software availability and technical supervision of the system. It will also provide round-the-clock technical support and a dedicated website enabling ZDiTM employees to both manage notifications and control the proper performance of maintenance tasks on an ongoing basis. In addition, GMV will provide programming services, consisting in introducing changes and improvements to the supplied software.

Szczecin's GMV-implemented Central Public Transport Management System, one of the most comprehensive not only in Poland but also in the whole of Europe, has been operating in full version since 2015.

In Szczecin there is also a ticketing system with GMV software, including the Szczecin Agglomeration Card (SKA), a network of Passenger Service Points as well as stationary and mobile ticket vending machines installed in almost all vehicles. The system supports contactless SKA cards (personalized and anonymous), which can be used both as season tickets and as a type of single ticket functioning under the "pre-paid" system.

The Szczecin city authorities are convinced that this investment in the maintenance and further development of the CSZKM system will pay off. In the hands of ZDiTM it is a professional tool for public transport management, significantly contributing to the improvement of the quality of public transport for the inhabitants.

Prize awarded to Mallorca's interurban public-transport technology

The integrated fare system, to come into operation with Mallorca's new scheduled road transport concessions, has won the Special ITS Prize 2019.

This groundbreaking project in Spain is being carried out by GMV for the Mallorca Transport Consortium (*Consorcio de Transportes de Mallorca*), which brings in a new integrated and multimodal fare system taking in the islands of Mallorca, Menorca, Ibiza and Formentera as well as technical assistance during the first years of operation.

The technological equipment to be supplied for this purpose is a blend of two technologies: contactless bankcard payment and smartcards (habitually used public-transport contactless cards), including the EMV payment service in collaboration with Redsýs and Banco Santander and incorporating all the advantages of an account based ticketing (ABT) system in the cloud.

The prize was awarded during the 19th Spanish Intelligent Transportation System Congress organized by the Spanish ITS Association from 1 to 3 April.

GMV supplies CRTM and Avanza with all-in maintenance

GMV has signed a maintenance contract with Grupo Avanza in the Regional Transport Consortium of Madrid (*Consorcio Regional de Transportes de Madrid*: CRTM). Under integral coverage this maintenance takes in all the fleet-management and ticketing onboard equipment as well as the control center, servers, managing systems and applications installed both in Avanza and CRTM. All incidents will be dealt with on a GMV maintenance website, which will keep a daily and almost permanent check of all anomalies that might crop up and coordinate all departments to deal with them.

The new contract has significant upgraded features, such as inclusion of the electronic fare-collection system in the contract, taking in the supply of about 550 onboard electronic ticketing machines ***ETC-606***, covering first-level corrective interventions in each bus garage. Equipment repairs, both fleet-management and ticketing, will be carried out in Madrid instead of Valladolid as hitherto; this new arrangement will cut repair times with a positive knock-on effect on customer service.

Another of the new features under this contract is the increase of bus-garage check-ins. Instead of two, as before, the buses will now have three night-time garage check-ins a week to deal with any incidents that may have occurred to the onboard equipment of both systems. This will make the repair system quicker and more responsive to any incidents in onboard systems.

This extension in the Avanza project for CRTM features another upgrade, i.e., inclusion of weekend on-calls to deal with any critical faults in onboard systems, such as positioning or connection between fleet-management and ticketing systems. This special attention entails an on-call technician who can reach the bus-garage quickly to solve any vital incidents in the onboard system.

Last but not least the contract also takes in a 7x24h on-call system to give remote coverage in incident repairs that might crop up in the control center or fleet-management and ticketing applications.

GMV participates in the enlargement of Malta's public transport

The Malta Public Transport (MPT) network, run by the company ALSA, comprises a 410-bus fleet of the models King Long, Otokar and Mercedes Cítaro. This wide-ranging network boasts onboard ticketing and fleet-management systems, plus an onboard video-surveillance system with permanent recording and real-time streaming replay.

Midway through this year there will be an enlargement of MPT's 40-bus fleet. This enlargement will bring in a technological leap in the onboard video-surveillance system, upgrading from analog CCTV to digital CCTV. The digital CCTV system will be based on PoE (Power over Ethernet) IP cameras, gaining better image resolution and an improvement in camera connection on the bus; this eliminates overlapping connections, since the Ethernet and power supply are integrated in a single connector. This new system also overrides the current analog-digital converter, reducing the likelihood of a failure of the whole set.

This enlargement will be carried out on buses bodied by the Turkish company Otokar. The buses will arrive with their ITSs pre-installed by the installers of Malta Public Transport for GMV to complete the installation and system testing in a quick and reliable way.

URBAN GreenUP partners meet up in Brussels to present project progress before the EC

URBAN GREENUP, WHICH AIMS TO DEVELOP A STRATEGY FOR RENATURING CITIES USING NATURE-BASED SOLUTIONS, IS BEING COORDINATED BY FUNDACIÓN CARTIF AND INVOLVES A WIDE-RANGING 25-PARTNER CONSORTIUM FROM 9 COUNTRIES FROM 3 CONTINENTS

On 12 and 13 March Brussels hosted the meeting to take stock of the results of the H2020-funded URBAN GreenUP project, which aims to develop a strategy for renaturing cities using nature-based solutions. On the following day, the 14th, the first official meeting before the EC was held.

This meeting, the fourth progress one of project partners took stock of breakthroughs achieved since the previous Liverpool meeting in 2018; presented the new developments in Nature Based Solutions (NBS) of the three demonstrator cities; drew conclusions and shared lessons learnt to date by partners and decided on the next steps. The review meeting also officially presented the state of the project after the first year to the EC

GMV is responsible for the work package dealing with the monitoring of renaturing measures and for implementing the App for monitoring use of the Green Corridor solution

auditors, tweaking the initial project planning, accounting for any changes and deviations and establishing contingency plans.

URBAN GreenUP, which kicked off in 2017, is being coordinated by the CARTIF Technology Center and carried out by a wide-ranging international consortium of 25 partners from 9 different countries from 3 continents. In Spain the Ayuntamiento (City Council) of Valladolid, through its Economic Development and Innovation Agency and with the collaboration of the regional ministries of town-planning and the environment, the River Duero Water Board (*Confederación Hidrográfica del Duero*), the technology centers CENTA and LEITAT and the companies Acciona, Singular Green and GMV, will be responsible for carrying out the planned project activities in the city of Valladolid itself. Together with Esmirna (Turkey) and Liverpool (UK), Valladolid is one of the project's three demonstrator cities. Ludwigsburg (Germany), Mantova (Italy), Medellín (Colombia) and Quy Nhon (Vietnam) are the follower cities whose remit is to reproduce the various solutions proven in the demonstrators.

Apart from the environmental benefits of projects of this type, such as increasing resilience to climate change and making cities healthier to live in, the project also aims to drive the green economy within the urban environment, creating jobs and new opportunities and business models. As well as technical actions the project also includes educational activities with public participation and activities to raise city dwellers' awareness about the environmental, economic and social benefits of green infrastructure.

Within this project GMV is responsible for the work package to monitor renaturing measures. Its final aim is to establish a monitoring scheme to gauge the impact of such measures in terms of improving cities' response to the abovementioned challenges (e.g. climate change). This will provide a robust data-driven, evidence-based monitoring and diagnosis scheme. GMV is also responsible for implementing an app for monitoring the use of one of the solutions to be implemented (Green Corridor), as well as bringing all actions to wider notice and culling public opinion on these actions to be implemented in their city.

GMV renews the DriveON operation and maintenance contract

DRIVEON IS A SYSTEM THAT ALLOWS DRIVERS TO USE HIGH OCCUPANCY VEHICLE (HOV) LANES IN TEXAS, USA HIGHWAYS NTE, NTE35W AND LBJ

GMV Sistemas and Cintra Toll Services have signed a new O&M contract for the operation and maintenance of the DriveON services and mobile application to run from 2019 until 2023.

DriveON is a system that allows drivers to use High Occupancy Vehicle (HOV) lanes in Texas, USA highways NTE, NTE35W and LBJ.

High Occupancy Vehicle and High Occupancy Toll Lanes are a key tool in Managed Lane Systems. HOV Lanes allow drivers to escape frustrating stop-and-go traffic. Enforcement systems and law enforcement agents ensure the proper use of HOV lanes by constantly monitoring traffic and lane usage.

DriveON system is formed by mobile applications (iOS and Android), one Webapp, one administrative web and corporate websites.

GMV developed an aid-system for managed lanes in order to accomplish a reliable, congestion-free trip with faster, more predictable drive times. With the mobile application and webapp, drivers can save time in their daily commuting by dodging the traffic; they also get HOV lane discounts just for using it. Users can schedule all their daily trips for the whole week and not bother about manual payments of any kind.

Other functions integrated in the system are messaging campaigns and promotions, toll product information, alert notifications, public real-time traffic and sensor information on the highway.

With this new contract GMV maintains and strengthens its relation with CINTRA, an important customer for the ITS Automotive area.

GMV developed an aid-system for managed lanes in order to accomplish a reliable, congestion-free trip with faster, more predictable drive times

GSA hosts the new ESCAPE project review meeting

On 9 and 10 April the Prague headquarters of the European Global Navigation Satellite System Agency (GSA) hosted the meeting to review the state of the ESCAPE project.

The GSA-funded ESCAPE project sets out to exploit Galileo services for the purposes of the much-vaunted autonomous driving. Its overriding aim is to create a positioning engine for automotive safety-critical applications, i.e., applications related to a highly automated driving.

During the first day representatives from each of the consortium firms (FICOSA, GMV, RENAULT, ST, UTC, LINKS and IFSTTAR) met up to decide on some end-of-project organizational aspects scheduled for late 2019. The questions addressed included planning over the coming months, the main awareness-raising events to present ESCAPE up to the end of the project and system validation procedures, both in the Joint Research Center (JRC) located in the Italian town of Ispra, 80 km from Milan, and in real scenarios, in this case in the French city of Compiègne, 90 km to the north of Paris in November.

The agreements reached and the current project state, now in the phase of in-vehicle system integration, were communicated to GSA representatives in the meeting held during the second day. Their suggestions, especially in terms of organizing awareness-raising events, were phased into project planning to the complete satisfaction of all parties.

GMV participates in the 19th Spanish Intelligent Transportation Systems Congress, organized by ITS España

In the first week of April Madrid served as the venue for the 19th Spanish Intelligent Transportation Systems Congress (*XIX Congreso Español sobre Sistemas Inteligentes de Transporte*), organized by ITS España. GMV took part in the connected-vehicle session, talking about its participation in C-ROADS, a joint initiative of EU member states and road operators for checking and deploying interoperable and harmonized Cooperative Intelligent Transportation Systems (C-ITS) throughout the whole European Union.

Patricia Alcalde, Head of Project of GMV's Automotive Business Unit, talked the congress audience through each of GMV's activities since joining the platform in February 2017, the company since then taking a full part in the project through its Spain and Portugal offices.

In Spain GMV is taking part in the Madrid Calle30 pilot scheme, developing the onboard unit (OBU) Day 1 and Day 1.5 services; these OBUs are fitted with an HMI (Human Machine Interface) Smartphone App to show users real-time information. In Portugal GMV is participating with roadside units (RSUs) rolled out along the whole Atlantic corridor.

Alongside development activities GMV is also playing a standout role as coordinator of analysis and evaluation activities, fundamental for drawing conclusions about the impact of introducing C-ITS in Spain on the basis of a series of previously-defined key performance indicators (KPIs).

GMV spearheading developments in the automobile sector

In line with the banner theme of this year's Mobile World Congress (February 25-28), "Intelligent Connectivity" GMV showcased its breakthroughs in the Automotive sector, along with the company's other current business lines.

GMV now boasts nearly two decades of work on the development of enabling technologies for the connected and autonomous car. Telematics, accurate and safe positioning and Cybersecurity are the three basic pillars underpinning its knowhow and expertise in this field.

GMV develops embedded software for Telematics Control Unit (TCUs); this has enabled many onboard telematic services to be phased into over 3 million vehicles now fitted with this software around the world.

It is also developing multi-platform service applications such as carsharing, car-pooling or mobility as a service (Maas); services for the electric vehicle, like battery-charge monitoring and notification systems, plus other systems such as navigation, infotainment or safety (eCall, bCall and recovery of stolen vehicles), among others.

One of the areas where GMV is really going from strength to strength is the development of advanced positioning technologies for the autonomous vehicle. In autonomous driving it is more than ever necessary to work with technologies and systems that ensure positioning of maximum precision, safety and reliability. Drawing on its proven experience in the space sector, GMV brings solutions based on global navigation satellite systems to the autonomous car.

GMV's Cybersecurity skills are also coming into their own in the connected and autonomous vehicle sector. GMV has been leading the development of security services in information and communication technologies in Spain for over 20 years now. It has by now become a national benchmark supplier of advanced Cybersecurity services and solutions in IP networks and ICT applications for the public sector and the development of e-Government. GMV decided to exploit the synergies between Cybersecurity and the automotive sector. Just as the connected vehicle offers many potential advantages, it also opens the door to many vulnerabilities. GMV is therefore working on the development of specific products to ensure proper protection of the autonomous and connected vehicle from malicious attacks, offering the sector the services and solutions it needs and allowing it to become more competitive and win consumer trust.

Road User Charging Conference 2019

On March 6 and 7 Brussels hosted the Road User Charging Conference 2019.

The basic idea behind road user charging (RUC) is charging for actual road use, with the primary goal of reducing congestion and keeping the road network both economically and ecologically sustainable.

With participants from around the world, the event was packed with key stakeholders, taking in both technical and policy-making perspectives. GMV was represented by Bruno Gonçalves in the role of industry delegate.

This year's RUC Conference showed a clear shift from congestion to the ecological side of mobility. The advent of electric vehicles poses new challenges, since these vehicles do not consume fuel, one of the direct sources of road-maintenance and -development revenue in many parts of the world.

On the other hand, new charging models are emerging, capable of substituting classic revenue sources. These new models are based on new technologies like precise positioning, cooperative systems or connectivity; these principles ensure proper charging of vehicles according to their level of emissions and dynamic pricing according to location or distance travelled.

Several top experts gave keynote speeches during the 2–day conference. Technology representatives focused on their electronic-toll-collection solutions; while public representatives took stock of the situation in their respective countries or cities, pointing out the different situations and challenges to be found across the globe.

GMV and open innovation in the LegalTech sector

On 21 March Finnovating, the strategic consultancy specializing in Open Innovation, put on the first unconference dealing with the LegalTech sector.

Under the banner theme: "More haste less speed; but more company more headway" they wanted to get across the need for building up this ecosystem steadily and collaboratively among the leading players of the sector, encouraging collaboration through specialized networking to achieve more successful results.

Rodrigo García de la Cruz, CEO of Finnovating, gave the opening address, presenting the sector's main figures and technological trends and stressing the fact that, despite the youth of the LegalTech sector, it is now thriving because the solutions it offers are in high demand by companies, lawyers' offices and users.

The conference brought together 80 CEOs from the legal sector's most innovative companies plus major corporations that are seeking to combine innovation with technology by means of collaboration with startups; these included GMV, the Spanish General Lawyers' Council (Consejo General de la Abogacía Española), Hogan Lovells and Pinsent Masons. On the strength of their solid track record in the sector, these companies are inputting great value and are capable of offering startups an in-depth knowledge of the industry,

financial capacity and a broad base of major clients.

GMV has built up a sound knowledge of the legal sector after years of collaboration with leading lawyers' offices that have turned to the multinational for the digitalization and Cybersecurity of their business. Isabel Tovar, Service Company Manager of GMV's Secure e-Solutions sector, stressed during the conference GMV's ongoing commitment to open innovation, which, taken together with its leading position, investment capacity and client base, makes it the ideal partner to help startups get their ideas across to end clients.

The first LegalTech Unconference finished with the prize-giving ceremony of the 1st Finnovating LegalTech Awards in four categories. The Best Business Model Execution award went to Reclamador. Biometix Vox won the Best Innovation award. LexGoApp won LegalTech's Enterprising Woman award while Testamenta won the Biggest Social Impact prize and Lawyou the Biggest Public Vote prize. Eva Martínez Ferrer, GMV's Business Development manager, handed over the prize to Testamenta, a startup that makes it easier for testaments to be donated to charitable organizations.

HITEC hails the General Manager of GMV's Secure e-Solutions sector

HITEC (Hispanic IT Executive Council), one of the premier global executive leadership organizations of senior business and technology executives, has hailed Luis Fernando Álvarez-Gascón, General Manager of GMV's Secure e-Solutions Sector, as one of the 50 most influential technology professionals working in Latin America, Spain and Portugal.

The "HITEC 50 2019" prize-giving ceremony was held during the HITEC 2019 Spring Leadership Summit staged in Charlotte, Carolina del Norte. Luis Fernando Álvarez-Gascón himself picked up the prize, thanking HITEC for this important recognition. He also expressed his commitment to help set up HITEC in Spain.

VirtualPAC, a groundbreaking virtualization solution for changing industrial processes

VirtualPAC, IS A GMV-DEVELOPED SOFTWARE PLATFORM FOR PLANT CONTROL EQUIPMENT TO MEET THE NEEDS OF ADAPTATION AND MODIFICATION OF PRODUCTION PROCESSES IN A RESPONSIVE AND SIMPLE WAY

Since its renaissance in the nineties of last century, virtualization has become one of the technologies with the biggest takeup in the IT sector thanks to its many advantages of cutting costs, boosting efficiency, reducing energy consumption, streamlining of backup and restoration operations, rapid post-disaster recovery and higher fault tolerance. These and many other benefits have turned it into a vendor-independent de facto industry standard.

Takeup is lower in the industrial worlds in comparison to the corporate IT world, especially in terms of process control equipment. In this situation it is crucial to be able to work with the necessary tools for simple and swift adaptation and modification of production processes. Essential here is the capability not only of parametrizing component machine-tool lines but also changing the whole process completely in a very short period of time. Another sine qua non is a control applications library than can be deployed remotely, reliably and securely in all equipment; this can be achieved by making use of cloud-distributed virtualized computing technologies (public, private or hybrid); they also need to be vendor independent, meaning they can be deployed in any hardware platform.

To come up with a response to this need GMV has developed ***VirtualPAC***, a software platform for plant control equipment, offering the following advantages over competing solutions:

- The control software is vendor independent and can be deployed in any hardware regardless of each manufacturer's particular control technology.
- The hardware in which ***VirtualPAC*** is deployed, whether it be a PLC or PAC, works in a virtualized way on ARM or x86 architecture.
- The equipment can host as many independent applications as its hardware capacities permit; each piece of equipment can also work and be operated in total independence from the rest.
- A higher density of applications per computer is achieved; this slashes the purchase- and maintenance-costs.
- Rollout and updating of applications control software is quick and easy.

Lastly, we should bear in mind here that today's hyper-connected environment is bound, now and in the future, to generate an unprecedented amount of data. Unless controlled properly, this could even jeopardize desired quality and production levels as well as exposing the firm to specific Cybersecurity risks. This is where virtualization technologies come in. They are true allies of the upcoming revolution and will play a crucial role in the change, as they have already done in the corporate digital world.

GMV presents its range of smart-city services, products and solutions

In Greencities, the urban sustainability and smart city forum, GMV has presented its portfolio of smart-city services and products, now set up in over 400 clients from 35 different countries. These included smart-city protection arrangements and mechanisms for monitoring and managing incidents that jeopardize service provision; air- and water-quality monitoring developments using smart sensors; smart citizen card for intermodal urban mobility, among others.

Miguel Hormigo, Industry manager of GMV's Secure e-Solutions sector, took part in the debating panel "Technological solutions for Smart Cities" moderated by Fernando García, Coordinator of the Smart City Interplatform Group (GICI in Spanish initials). Hormigo explained how typical Industry 4.0-type disruptive technology can be extrapolated to cities for providing new services of value to their citizens. Just as in industry town- and city-councils also need to digitalize their business, their portfolio, and the vertical and horizontal linkages of the value chain and be able to measure results. By applying Business Intelligence and Big Data technologies, public managers can obtain evidence on citizen needs and come up with answers, adapting services to suit and improving the quality of life.

Furthermore, application of micro indicators like productivity, quality of life, infrastructure development, environmental sustainability, fairness and social inclusion guarantee the effectiveness of the services rolled out to meet public-sector client needs, i.e., citizens, and drive change by channeling demands.

Similarly, enabling technologies like Big Data, cyber-physical systems, robotics, cloud computing, IoT and other disruptive, traceability-boosting technology like Blockchain will enable us to offer autonomous, smart services. At the same time, smart cities, increasingly connected cannot afford cyber-weaknesses that might jeopardize citizen data and services.

Smart Energy Congress, trends and opportunities

The great revolution we have been living through in recent years is an ongoing process of social, technological and economic transformation stemming from the massive takeup of Internet in the mid-nineties of the last century in successive applications to various socioeconomic environments. The development underway today is largely industry-centered. In this context innovation comes across as a strategic business-development need. The incorporation and application of talent is also a key factor in the success of new business models that have yet to gel. All these issues were dealt with by Miguel Hormigo, Industry Sector Manager of GMV's Secure e-Solutions sector, during his intervention in the debate on new trends and opportunities of the Smart Energy Congress, held in Madrid on 3 and 4 April.

Miguel Hormigo gave a brief account of the impact of the first industrial revolution and its similarities with what we have come to call Industry 4.0. He then went on to distinguish the convergence, personalization and technologies that have been fundamental in carrying through this new digital transformation, which is boosting operational efficiency and bringing in new business models. The paper focused above all on how the automation of Industry 4.0 is evolving, a crucial factor in achieving greater productivity, resource efficiency, quality and security. He also commented on what is still to come, such as 6G or the new breakthroughs in collaborative and virtual robotics.

In this industrial environment the new technologies are speeding up the fusion of the worlds of virtual design and physical equipment, calling for the creation of new business models destined to support digital-service-enabling IT and OT convergence. There is now a growing demand for personalized services to suit the particular needs of each client. This has spawned all the following: new services to enable clients to participate directly in personalization of the products to be purchased; subscription models; collaborative economy; Manufacturing as a Service (MaaS), Do It Yourself (DIY), among others. Another important trend brought out by Hormigo is the demand for a "greener" industry, renewable energy sources and the need for industry convergence. After all, 3 out of 4 persons belonging to the new generations would be prepared to pay more for sustainable products and services.

CiudadesAbiertas.es, the window that opens up the City Councils to their citizens

THE MAIN AIM OF CIUDADES ABIERTAS IS THE FULL DEVELOPMENT OF OPEN-GOVERNMENT POLICIES IN THE PARTICIPANT CITIES, DOING SO BY ENCOURAGING THE PUBLICATION OF OPEN DATA, DEVELOPING PARTICIPATIVE PROJECTS AND PUBLISHING TRANSPARENCY-FAVORING SERVICE INFORMATION

Ciudadesabiertas.es has recently been launched. This is a space pooling all information on the "Collaborative and Interoperable Open Government Platform". This platform is conceived as a project gateway where the public at large, in a transparent and participative way, can find out all about open data, vocabulary, project milestones and progress, making suggestions and inputting their own information in the interests of the councils' ongoing open data initiative.

With an outlay of over two million euros, 40% furnished by the city councils of A Coruña, Madrid, Santiago de Compostela and Zaragoza, and 60% by Red.es thanks to co-funding from the European Regional Development Fund (ERDF), the Collaborative and Interoperable Open Government Platform's main aim is the full development of open-government policies in the participant cities, encouraging the publication of open data, developing participative projects and publishing inherently transparency-favoring service information. This all draws on the technology of a project-specific joint venture run by GMV in collaboration with the Universidad Politécnica de Madrid and LocaliData.

The creation of a long-lasting collaboration ecosystem drawing on groundbreaking open-government ICT solutions and methodologies, based on participation, co-creation and re-use, will allow the city councils of A Coruña, Madrid, Santiago de Compostela and Zaragoza to boost their efficiency and optimize innovation and technological resources, increasing their scope. This will clearly redound to the benefit of these cities' citizens, who will be able to obtain top-quality public services to meet their needs, having themselves taken an active part in the city-improvement decisions.

Digital Democracy, the challenges of a cashless economy

The advent of new technologies and their application as means of payment tends to give the impression that cash in on its way out in the near future. Belying this impression, however, in most of the world's countries cash is still almost as essential as it was a few years ago, and its demand is still growing.

The Managerial Progress Association (*Asociación para el Progreso de la Dirección*: APD Colombia) and the publishing house Kienyke, have come together to analyze the across-the-board implications of a totally digitalized economy, doing so by holding a conference called "Digital Democracy, challenges of a cashless economy".

The encounter involved a debating panel on the pros and cons of cash and the importance of the financial sector's digital transformation in Colombia. Victor Gaspar, GMV's Country Business Manager for Colombia, took part in the debate by pointing out the barriers to a cashless existence: innovation-throttling regulation overkill; lack of knowledge and interest, etc. Another of his main thrusts was the need to unify financial-sector regulations to allow companies to expand without hindrance, for example with improvements like GDPR. Victor Gaspar argued that a proper digital transformation also depends on removing cultural barriers, seeking solutions to clients' real problems, like reluctance to change.

As for the main advantages offered by the financial transformation, Gaspar itemized competition, boosting consumer sovereignty and cutting down the monopoly power of current stakeholders. In a more digitalized environment the consumer is given more affordable options, such as Apps for making swift and simple money transfers (Revolut, TransferWise, etc). Startups can now break into the market offering a single product or service in a swift and economically feasible manner, eating into the profit margins of the big players.

GMV helps the Junta de Castilla y León hold its third Open Data Competition

For some years now the Regional Council of Castilla y León (*Junta de Castilla y León*) has been keenly supporting the "Open Government" movement as a direct communication channel between the regional government and its citizens, tapping into the new ICTs and abiding by the principles of transparency, collaboration and citizen participation.

One of the regional government's initiatives as part of this ongoing endeavor is to hold the "Open Data Competition", which rewards projects that supply any type of idea, study, service, educational resource, website or handheld app that draws on the Open Data Portal made available to its citizens by the Junta.

On all the three occasions the competition has been held, the Junta de Castilla y León has been supported by GMV, the company thereby showing its ongoing commitment to data reuse and harnessing, the importance of transparency and the support of budding talent. Not only does the company sponsor the prizes but it also sits on the jury together with representatives of the regional government.

GMV recognized for its capability of identifying and mitigating Artificial-Intelligence bias

Artificial Intelligence is making increasing inroads into today's society and pundits say it is likely to make even further headway in the future, until it finally becomes part of our daily decision-making procedures or even replaces them. We are speaking about everyday cases like the granting of a mortgage, assessing the likelihood of a criminal reoffending or deciding on the best way of distributing medical resources. These ongoing developments have sparked off an ethical debate about leaving certain decisions up to technology, especially in view of the fact that recent studies and publications have pinpointed discriminatory biases in these smart systems.

To confront this problem Telefónica's Data Unit (LUCA) has organized an international challenge to encourage reasonable use of Artificial Intelligence. GMV's Artificial Intelligence and Big Data team led by José Carlos Baquero, rose to LUCA's challenge, winning the competition's second prize.

The work involved analysis of an open data set of Spain's National Statistics Institute (*Instituto Nacional de Estadística*: INE) about salaries in Spain, showing there is a gender-based salary gap, with men more likely to reach highly paid positions.

First of all the system showed that this inequality still exists even when gender-based information is cancelled out. A model was then trained up with this data showing that it learns this bias. If this first salary-forecasting model were used to make decisions on the person concerned, this would give rise to discriminatory decisions.

Working from this premise the GMV's team made up by Alexander Benítez, Paloma López de Arenosa, Antón Makarov and Inmaculada Perea, presented a solution to lessen the data bias and train up a new model based on this data, generating fairer predictions while hardly affecting performance, thus lessening gender discrimination.

How can artificial intelligence be phased into firms?

Although the takeup of artificial intelligence is still in its infancy, there are already many companies who fall into the "early adopter" group with interesting use cases to tell. IDG Research Services sees AI as the next great disrupting factor in business, which cannot be put off or ignored.

For this reason, on 27 March, IDG put on AI Roadmap 2019, in which several top companies have explained how they have integrated AI and a panel of professionals has given its take on the current state of play and the sector's future prospects. José Carlos Baquero, Big Data and AI Manager of GMV's Secure e-Solutions sector, was one of these guest experts.

AI is nothing new for GMV; for years now the company has been using cutting-edge technology to show up bank fraud, pinpoint threats and streamline industrial processes, as well as for predictive maintenance, client segmentation and scoring, knowledge management, conversational Interactive Voice Response (IVR) technology, voice recognition and indexing, facial identification, training, technology consultancy, etc.

GMV advocates the co-creation model, which allows for tailor-made developments, combining, on the one hand, the client's inside knowledge of its own business and problems with, on the other, GMV's expertise and resources to connect precisely with the best use case. GMV helps its clients to identify those use cases where AI could be applied, either to improve a process or product or even to create new products from data.

IDG looked at a matter of the utmost importance, the possible partiality deriving from algorithm biases inherent in the data itself. This situation could lead unknowingly to unfair, discriminatory decisions. To tackle this problem GMV is analyzing different techniques in three phases of algorithm design: firstly, prior data processing, when the data per se already has biases; secondly, during training, using algorithm-penalizing techniques that preempt any learning from these biases; and, finally, in the post-processing procedure by means of thresholding.

Leading the GMV of the future: nothing is impossible

As part of the company-boosting actions grouped under the hashtag #BoostingGMV, a scheme initiated at the end of 2018, the team of nearly 200 professionals making up a representative set of GMV management came together for the first time in a day-long convention held in the Tres Cantos castle called Castillo de Viñuelas. Its remit was to look at GMV's current challenges and opportunities and its outlook for the future, while also allowing personnel from various areas and sites to get to know each other and share their GMV experience.

The opening address was given by GMV's CEO, Jesús Serrano. After welcoming everyone his speech focused on GMV's DNA and hallmark features, like talent, competitiveness and sustainable growth, all of which have helped us get where we are today. He was followed by various line bosses giving their own particular vision of the future in their corporate area. After the CEO's conclusions, giving a very ambitious idea of GMV's growth prospects under the premise "Nothing is impossible", the meeting was thrown open to questions from the floor, sparking off a lively and fruitful debate.

The convention then continued with diverse workshops giving participants the chance to express jointly their ideas about which aspects of GMV they rate most highly and which least, plus proposals for improvement and their particular group vision of the firm's medium- and long-term future.

The conclusions drawn from this analysis will help us to boost the most highly rated aspects and work on those with room for improvement.

The closing address was given by GMV's President, Mónica Martínez, who took this chance to highlight the human and professional quality of her teams, summing it up as follows "Effort can bring you good results, but only passion can get you excellent results".

GMV sponsors the Grand Final of the FIRST LEGO League

THE FIRST LEGO LEAGUE IS A PROGRAM THAT ENCOURAGES THE TAKEUP OF SCIENTIFIC-TECHNOLOGICAL CALLINGS AMONG THE YOUNG BY POSING AN ANNUAL CHALLENGE IN WHICH THE PARTICIPANTS HAVE TO SOLVE A REAL-WORLD PROBLEM

GMV participated as sponsor of the Grand Final of the FIRST LEGO League 2018-2019, held in Adeje (Tenerife) from 22 to 24 March.

As in every previous year FIRST LEGO League challenges kids aged 10 to 16 to think like scientists and engineers.

The challenge for FIRST LEGO League 2018-2019 was "INTO ORBIT"; participating teams had to travel to into space to explore, surmount challenges and innovate within its vast expanse. To do so, the teams had to carry out a scientific project to solve a real-world problem. They also built, tested and programmed an autonomous robot using LEGO MINDSTORMS technology to solve a set of missions in the robot game, operating at all times under the FIRST LEGO League signature set of values.

Within the FFL Talks section, Miguel Ángel Molina, Commercial and Contracts Manager – GMV Aerospace, gave a chat called "The space sector and the encouragement of technical careers" before handing out the GMV award for strategy and innovation.

Faithful to its university roots in the Universidad Politécnica de Madrid, GMV is firmly committed to nurturing budding talent. It therefore combines its business activity with initiatives to support and encourage the takeup of scientific-technological careers among the youngest sectors of the population.

The challenge for FIRST LEGO League 2018-2019 was "INTO ORBIT"; participating teams had to travel to into space to explore, surmount challenges and innovate within its vast expanse

GMV, a cutting-edge technology firm, takes part in the latest MWC

From 25 to 28 February GMV was present at the latest Mobile World Congress (MWC), which brings together every year the top handheld manufacturers and cutting-edge technology firms, turning Barcelona into the world technology capital.

In line with the banner of this year's congress, "Intelligent Connectivity", GMV showcased its range of solutions for intelligent transportation systems, including geolocation solutions, fleet management systems, passenger-information and ticketing systems. GMV boasts a wealth of experience in this area, as Spain's number-one supplier of telematic systems for public transport. This expertise has also spilled across Spain's borders, where the company has reach far-reaching agreements elsewhere in Europe as well as in the Americas and Asia.

GMV also presented inhouse mobile apps and services for the connected car and autonomous vehicle, automotive platforms, as well as high-integrity precise-positioning systems. GMV develops trailblazing technology and services for sustainable and connected mobility.

GMV also showcased its technological skills for digitalizing various sectors such as industry, telecommunications and banking, on the strength of groundbreaking technology like Big Data/AI, IoT, cloud computing, collaborative robotics, chatbots, etc. GMV provides integrated solutions and engineering services of Cybersecurity, intelligence centers and security governance, managing technological risks and ensuring compliance with applicable standards and legislation.

GMV takes part in the third STEM Talent Girl in Valladolid

Over 500 female pupils attended the third STEM Talent Girl on 7 March last in Valladolid. This is a program to steer female talent towards careers in science, technology, engineering and mathematics (STEM).

This initiative was born in response to the low percentage of females in studies of this type and, in the longer term, in STEM careers afterwards.

STEM Talent Girl kicked off back in November 2017 with "Talent Search" a systematic search for budding talent among female pupils; this program was topped up with the masterclasses and shadowing sessions, led by the 2500-strong team of female mentors.

Verónica Pascual, CEO of ASTI, gave the opening address this year as well as a masterclass on the program. The pupils then had the chance to tour the stands being run by universities, technology centers and firms like GMV, who were supporting the event by guiding the girls towards career outlets.

A special guest on GMV's stand showcased its FOXIZIRC rover as a good example of current developments in the robotics world. This rover takes its cue from FOXIRIS, a platform previously developed for the ARGOS Challenge of the oil company TOTAL. It is currently being used as a testbed for GMV's visual odometry (SPARTAN) and self-navigation systems plus the autonomy solutions (GMV-BRAIN) for planetary-exploration rovers.

This program is also geared towards STEM professionals to set up a team of mentors who will help the girls find their feet in this world.

GMV is contributing three mentors to this initiative: Beatriz García Navarro, involved in machine to machine (M2M) research projects and the company's intelligent transportation systems (ITS); Patricia Alcalde Caldevilla, head of in-vehicle telematic control unit projects in the automobile sector; and Fátima López Mateos, head of European H2020 and Aftermarket projects focusing on Smart Cities and sustainable mobility projects.

For her part Mariella Graziano, GMV's Space Segment and Robotics Director, gave a session on 23 March in Segovia Public Library, talking about her own science and technology career as inspiration for the audience to follow her example. Mariella Graziano is also a member and supporter of various international associations like Women in Aerospace Europe.

GMV backs initiatives of this type to make good its ongoing commitment to the development of budding talent and to bring science-technology careers to wider notice among the younger sectors of the population.

ÁNGEL GAVÍN

«Journey or career move? For me, without doubt, it's been a journey»

In 2000 a would-be theoretical physicist struck out on a literal and metaphorical journey from his hometown of Zaragoza to Madrid, to work for GMV. Although some would call this a career move, with the years I've discovered that it is in fact a journey. A career is an all-out struggle against others or even yourself, with pre-set goals and a chosen route. A journey, on the other hand, lets you explore hitherto unknown places, nip down shortcuts or stray from the planned route. And always enjoying and learning from everything along the way and from your travelling companions too.

That would-be physicist was me. At some point along the way I switched from quantum physics and the theory of relativity to matters like management, innovation, artificial intelligence and Cybersecurity, among many others. Unthinkable, if anyone had told me this on finishing my degree.

THE JOURNEY STARTS

My journey starts when I joined GMV's Global Navigation Satellite System (GNSS) unit back in 2000. I learned a profession that was born practically at the same time as me: software engineering. I had the huge luck of working on Europe's Galileo navigation system almost from its very beginnings. I learnt the fundamentals of system engineering and worked with the highest imaginable quality standards. I specialized in software development.

I had a host of responsibilities, ranging from project engineer to line manager; after a year-and-a-half I ended up running my own project, ***polaris***, where I learned about a lot more than just running projects. I worked with an exceptional, multidisciplinary team, all of whom blended in and complemented each other perfectly. I found out there was plenty of room for new ideas.

I soon discovered there was an internal usability group, designing and producing intuitive, user-friendly graphical interfaces. We can hardly claim to have coined the term "usability" (far from it) but even though today's buzzword is User Experience (UX), some of my colleagues already had this outlook back in 2000 in a sector as professional and engineering-intensive as space. Many of the ideas bandied about at that time ended up forming part of our star products, but even more important was the fact that the interest group was

POST: Business Partner. GMV's Secure e-Solutions sector/ International Markets

DOB: August 14, 1971

ACADEMIC QUALIFICATIONS: Bachelor's degree in physics and mathematics. Master's degree in strategic management and innovation management

START DATE: March 1st, 2000

OFFICE: Zaragoza

HOBBIES: Photography, writing and reading. Speaking in public

DEFINES HIMSELF AS: I'm totally useless with my hands so I have to cultivate other areas of myself like inquisitiveness, a faith in my own creativity and continuous learning. I'm a true technology freak and love to swap ideas with like-minded people. I try to make sure everything I communicate is in some way educational and eye-opening

transversal; this allowed me to get to know a load of colleagues and find out what was happening in the company's other business unit.

From GNSS I was lucky enough to work on products with other group companies. Intelligent transportation is a fundamental application of systems like Galileo, so, practically from the word go, I began to collaborate with the Intelligent Transportation Systems company. Nor was that all: the fact that Galileo software development calls for an ever-increasing number of web developments and security management naturally led me to work on projects with other GMV subsidiaries like Secure e-Solutions (or SES as it's known internally).

CURIOSITY KILLED… NO ONE!

I don't know if curiosity has ever actually killed a cat but it certainly never harmed anyone in GMV. The common thread running through the projects was GNSS, but we all learned from each other. In GNSS we began to incorporate design-up security as well as web interfaces. SES began to learn about and apply Galileo standards. Twelve years later the GNSS projects are an essential part of SES, and GMV is even spearheading critical areas like Cybersecurity of the whole Galileo control segment and signal encryption (sKMF).

This inquisitiveness about new technologies and ways of working is a constant feature in GMV. We are lucky enough to work with people who are at the cutting edge of technology trends, in sectors open to taking them up.

TO FOMENT OR NOT TO FOMENT: THAT IS THE QUESTION!

At a given moment of my professional journey I began to take an interest in the ways of fomenting innovation, so I took a master's degree in Innovation Management and Strategic Management. This rewired my thinking processes. Promoting innovation in an innovating firm is a straightforward matter, but far from problem free. To feel that your opinions on any matter are heard and heeded by both management and colleagues is really priceless.

I've always tried to promote innovation at all levels, sometimes successfully and other times... let's just say "less so". But that's what innovation is all about. Working in a firm that is passionate about challenges, teamwork and has a hard-wired respect for opinions is a help. A great help.

As things turned out, however, I had to move to Zaragoza in 2014 for family reasons. I left GMV with a lump in my throat. I was outside the firm for six months, six long months that showed me we all have a natural career berth, and mine is GMV. It was a veritable personal and professional fiasco but I learned a lot of things about myself and the business world.

I struck lucky; I was able to return to GMV from Zaragoza, joining SES. Learning about new sectors like banking and industry was hard to start with but my previous experience had allowed me to contribute as Business Partner in the international market, and also to work at the cutting edge of technology in areas like artificial intelligence, Big Data and Cybersecurity. We boast real experts and I try to pollinate these ideas across the different areas.

THE JOURNEY GOES ON

And here I am nearly 20 years later. I know where I've come from, where I've been and where I am now. And I know that GMV is my place in the world. But who knows what my suitcase will hold twenty years on?

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