

OHB Magazine

The customer magazine of the OHB Group

Anniversary: 35 years of OHB

The incredible success story of an aerospace company which started off as a minor ship supplier

PLATO, JUICE & Co.

OHB is currently involved in many exciting ESA scientific missions

New Space@OHB

Promoting new business ideas for the international spaceflight market



*Entering a new era
with a pioneering spirit*
Telecommunications for the world



The Hispasat 36W-1 satellite, based on the SmallGEO platform, lifted off on a Soyuz rocket from Europe's Spaceport in Kourou, French Guiana. SmallGEO is Europe's response to the market demand for more flexible, modular telecommunications platforms. It marks the first time the OHB System AG have been the prime contractor for a telecommunications satellite mission.

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Dear Customers, Business Partners and Friends of OHb,

As one of the three major European space system integrators, it is a tradition for us to show our skills as a group. The best occasion to get in touch with our customers and friends is an exhibition and we are proud to meet you here again.

We are publishing this magazine to mark the occasion. This Exhibition Special offers you a glimpse of our OHb universe. As previous issues, it contains news and facts from OHb.

The successful launch of our first SmallGEO telecommunications satellite and its excellent performance in space is one of our major milestones. The main story introduces the Hispasat 36W-1 Telecommunication Satellite, the Small-GEO satellite family and its significance for us.

With the launch of Ariane 5, flight VA 233, we celebrated two major steps for our company: for the first time, four Galileo FOC satellites were simultaneously launched by an Ariane 5 rocket in November 2016 with us contributing to the launch vehicle and the satellites.

We also take a closer look at ESA's Science missions and present a special, small high-tech spacecraft called Max Valier-Sat. There is even more to celebrate as the new year meant 35 years since my family took over the five-man company OHb, paving the way for today's Group. There is lots more inside for you to discover!

I hope you enjoy reading our news.
With kind regards

Marco R. Fuchs

Marco R. Fuchs
Chief Executive Officer, OHb SE

The next big step

OHB's first SmallGEO, Hispasat 36W-1, is perfectly operating in its geostationary orbit. Our group of companies has once more reached new spheres and markets.



Public Now, 28 January 2017
"OHB with a successful launch
into a geostationary orbit"



Dr Gerd Gruppe, Director Aerospace Management at DLR
"SmallGEO demonstrates that Germany is once again capable of developing and building communication satellites."



"The launch is a major milestone in the history of OHB. Hispasat 36W-1 is the first project of a wide scope of future missions based on the SmallGEO platform, including a revolution in satellite technology: the full electric propulsion mission Electra."

Marco Fuchs, CEO of OHB



Die Welt, 31 January 2017
"A return to the top league - For the first time in 20 years, a German-built geostationary satellite is orbiting the Earth at an altitude of 30,000 kilometres"

Flugrevue, 30 January 2017
"Another telecommunications satellite from Germany"



Aviation Week & Space Technology, February 6-19, 2017
"Joining the Big Boys – Galileo satellite manufacturer OHB expands its product range"



Stuttgarter Nachrichten, 7 February 2017
"The space race has begun"



Oberösterreichische Nachrichten, 28 January 2017
"New 'SmallGEO' satellite platform successfully launched"



Die Welt – N24, 29 January 2017
"The Fuchs family has made more progress in space than Elon Musk"



Matthias Machnig, State Secretary at the German Ministry of Finance and Energy
"Another chapter of German aerospace history was written today after the successful launch of the H36W-1 telecommunications satellite."

"We thank ESA and OHB because this new satellite represents an important step forward in Hispasat's innovation strategy."

Carlos Espinós Gómez, CEO of Hispasat

"The launch of this first SmallGEO platform marks another major success for ESA's programme ARTES, which aims to boost the competitiveness of its Member State industry through innovation."

Magali Vaissiere, ESA's Director of Telecommunications and Integrated Applications



NEWS



New OHB subsidiary: Blue Horizon relies on life science

Barren deserts are transformed into floral landscapes, conditions friendly to life gradually evolve on the surfaces of dead celestial bodies such as the moon and Mars.

These visions may become reality in a not too distant future – thanks to the Luxembourg-based company Blue Horizon, established on 4 April as a joint venture between the OHB subsidiaries OHB Venture Capital GmbH in Munich and LuxSpace Sarl in Betzdorf, Luxembourg. “Blue Horizon represents a logical step for OHB. We are using it to further develop our useful aerospace activities to the benefit of our lives here on Earth”, explained OHB CEO Marco Fuchs when the start-up was announced.

Blue Horizon has the task of creating the conditions for sustainable life in space and revitalising ravaged landscapes on Earth. Both are made possible by technologies and methods from the area of life science – an area in which OHB System AG avails of extensive know-how which is now to be integrated in the new company. Furthermore, Blue Horizon will closely co-operate with various European research institutes.



From left: Prof. Dr Klaus Slenzka (Chief Scientist at Blue Horizon), Marco Fuchs (CEO OHB SE), Etienne Schneider (Deputy Prime Minister of Luxembourg and Minister for Economic Affairs), Dr Mathias Link (Ministry of Economic Affairs, Space Affairs Department) at the press conference on the establishment of Blue Horizon

MT Aerospace commissioned with additional components for Boeing SLS



Artist's concept of NASA's Space Launch System, the most powerful heavy-duty launcher to date for deep space missions

The US aerospace corporation Boeing has commissioned MT Aerospace with further development work for the Space Launch System (SLS) – NASA's most powerful heavy-duty launcher to date for manned and unmanned missions to the moon, Mars and the depths of space. Since mid-2013, MT Aerospace has been

developing and manufacturing large aluminium segments for the fuel tanks of the SLS main stage. With a diameter of 8.4 metres and a length of approx. 65 metres, they have a capacity of almost 1.000 tonnes of liquid hydrogen and oxygen, and are 30 per cent larger than the outer tank of the earlier Space Shuttle.

JUICE – EM blocks to be qualified



Conceptual image of the JUICE space probe by Antwerp Space

As of 2022, the ESA will be using JUICE to explore Jupiter and three of its largest moons. The communication system, including development, integration and testing, is supplied by Antwerp Space, for which the JUICE COM team heads a European consortium of suppliers. “After kick-off in late 2016, we have now entered the interesting phase of Engineering Qualification Status Reviews in which subcontractors are obliged to prove that their equipment delivers the requisite performance”, explains Project Manager Mattias Genbrugge. All information for the System Level Assessment is merged at Antwerp Space to enable the development of the ground test equipment as it's only just under a year until the test campaign for the engineering model begins in the new clean room at Antwerp Space.

Farewell, SOLAR!



SOLAR was transported to the ISS on board the “Atlantis” Space Shuttle (top) and worked successfully on the “Columbus” module for nine years.

The external ISS SOLAR payload for exploring the sun was decommissioned on 15 February after a successful nine-year mission. Together with the EuTEF payload – entirely developed, built and tested by OHB Italia – the instrument was transported to the ISS in February 2008 on board the “Atlantis” Space Shuttle (Mission STS122E) before being docked to the European Columbus module and activated eight days later. SOLAR has therefore far exceeded its planned operating period of three years. OHB Italia was responsible for the entire development cycle of the payload control unit (CU) displayed by this complex system used for solar observation.

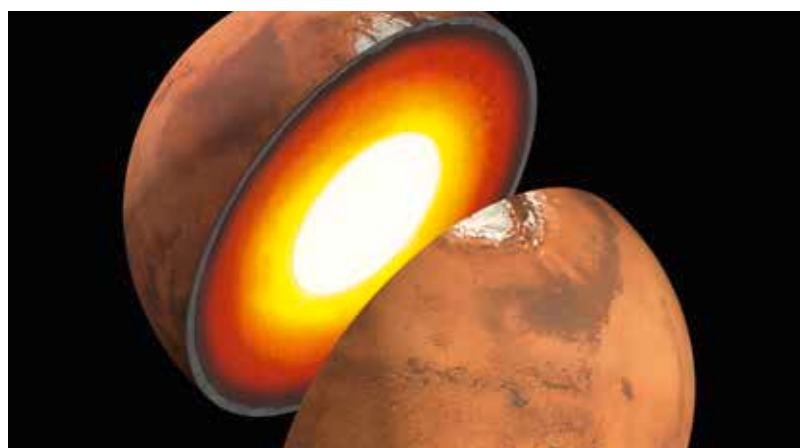


Orion spaceship at test site



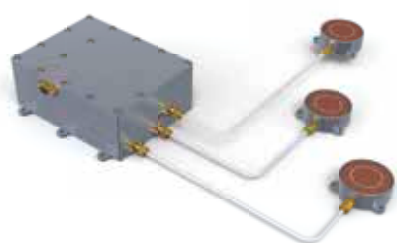
After a year of intensive work, OHB Sweden has successfully concluded integration work for its key contribution to NASA's Orion spacecraft. Our colleagues in Kista were commissioned to complete the Propulsion Qualification Modul (PQM) for the European Service Module. In mid-January 2017, the PQM departed the company's site and was received on the NASA test site in White Sands, New Mexico, in February for subsequent final integration of key components such as the main drive unit in preparation for the hot-flame tests. "We are proud and happy that we were able to complete our contribution to the ESM so fast and successfully and that we are able to contribute towards finalising qualification of the ESM for its maiden flight", claims Gierth Olsson, CEO at OHB Sweden.

Key milestone for LaRa



Commissioned by the ESA, Antwerp Space is building the scientific instrument LaRa (Lander Radioscience) flying to Mars along with the ExoMars Mission in 2020. Following successful conclusion of the preliminary design review, a key milestone has now been achieved for this project. The LaRa team is currently defining the interfaces for the ExoMars surface platform on which the instrument is to be integrated. LaRa is fitted with sophisticated communication technology transmitting ultra-precise measurements to Earth on the alignment and rotation of the red planet. "We are very proud to be building the

first Belgian instrument to be used on the surface of Mars. And we are correspondingly enthusiastic about working on this ambitious task", claims Vincent Bath, Business Development Manager at Antwerp Space.



Ariane 6 launch pads right on schedule

Commissioned by its parent company, MT Aerospace, MT Mechatronics is responsible for the mechanical systems of the launch pads for the new Ariane 6 and is right on schedule following a successful project review. The team based in Mainz is in charge of planning, delivering and commissioning the mechanical systems for the European spaceport in Kourou, French Guiana. The plants are to be handed over to CNES and the European Space Agency (ESA) in May 2018. Observance of this deadline is a prerequisite for the first launch of the new European Ariane 6 carrier planned for 2020.



MT Mechatronics builds 40-metre radio telescope



In mid-March, MT Mechatronics GmbH was commissioned by the National Astronomical Research Institute of Thailand (NARIT) in Chiang Mai to build a 40-metre radio telescope. It is a turning head model operating in the frequency range of 5 - 100 GHz. MTM already delivered a similar model to the Instituto Geográfico Nacional in Spain in 2005. Following commissioning of the new telescope in Northern Thailand in three years' time, these two radio telescopes will be among the largest and most powerful of their kind.

Hexapod stable – thanks to OHB Italia

On 19 February, the Dragon spacecraft developed by SpaceX was launched for the first time from the Cape Canaveral spaceport, with the NASA SAGE-III instrument also on board towards the ISS. It has the task of examining global, long-term development of the most important atmospheric parameters such as the distribution of aerosols, ozone, water vapour and nitrogen dioxide. One key component of the instrument is the ESA "Hexapod Pointing System" (HPS) with an essential contribution made by OHB Italia. The six-legged HPS is essentially there to maintain the stability of the ultra-precise scientific instruments during their sensitive measurements. Commissioned by TAS Italy, OHB Italia is responsible for construction, integration and testing of the Hexapod Mechanical Assembly (HMA) and the Hexapod Electronics Unit (HEU). "We are delighted to contribute to the success of the SAGE III Mission and its valuable scientific information", states Roberto Aceti, CEO at OHB Italia.



2016 annual balance sheet: stable results achieved

Our corporation achieved an overall performance of €728 million in 2016, only barely falling short of the good level of the previous year (€730 million). One positive effect is that all earning parameters exceeded both the values of the previous year and the projected values for 2016 as well as leading to corresponding improvements in margins.

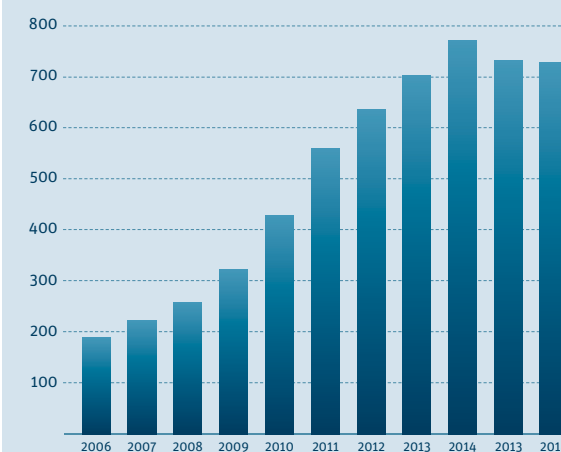
While profits before tax and write-downs (EBITDA) increased from €52.1 million in 2015 to €55.1 million in 2016, the operating result (EBIT) rose from €40.2 million to €42.7 million over the same period. And consolidated net earnings after minority interests increased from €21.0 million to €22.2 million.

Our "Space Systems" division achieved unconsolidated total revenues of €559.5 million in 2016 (as opposed to €553.1 million the previous year). The operating result for the satellite programmes rose from €24.0 million to €25.5 million. In the "Aerospace + Industrial Products" division, unconsolidated total revenues for fiscal 2016 accounted for €175.9 million.

Orders remained at a high level to the value of €1,560 million (€1,684 million in 2015), whereby the lion's share (€1,341 million) was accounted for by the "Space Systems" division with "Aerospace + Industrial Products" contributing €218 million. This guarantees satisfactory planning security for the future as well as a high degree of operating capacity utilisation in all divisions.

The Board anticipates unconsolidated total revenues of €800 million for 2017. The operative earning parameters EBITDA and EBIT are to achieve €60 million and €44 million, respectively.

Total Group revenues in EUR million



As at 31 December 2016

MTG takes shape



The hardware phase for MTG, Europe's future weather satellites, is progressing well at both OHB System sites (end customers: ESA/Eumetsat; prime contractor: Thales Alenia Space). In the clean room in Bremen, where each of the six satellite busses is being manufactured, the development models have been fully set up for validating the design. The structural and thermal model for the platform has already withstood the extreme temperature conditions of the thermal vacuum chamber as well as successfully passing the micro-vibration test. Integration of the first two flight models has already been underway for several months. Our colleagues at AnwerpSpace are providing support in the form of their ground support equipment. In Oberpfaffenhofen, the integration and test phase for the optical instruments for the two MTG Sounder satellites and for the telescopes of the four MTG Imager satellites has also commenced. The structural and thermal model of the FCI telescope is currently being set up. An initial stability test has shown that the optical bench – the heart piece of the telescope – does not deform even under extreme temperature conditions, and retains its precision. The essential tests on satellite bus and FCI telescope development models are to be concluded at both sites by the end of the year.

OHB VC invests in astrofactum

Since mid-March, OHB Venture Capital has been investing as a strategic partner in the aerospace start-up astrofactum. This young company aims to "democratise space" by enabling a wide range of users to gain access to astronomical applications from space. First of all, free terrestrial and satellite-bound surveillance capacities are to be bundled and made available to an international user community. astrofactum also plans to push the "Public Telescope" project as a successor to Hubble. What's new about the business model is the unlimited access provided for private astronomers and persons from the education sector. But the science sector will equally benefit from the space telescope as it closes the gap for observations in the ultraviolet spectral range which will arise as of 2020 when the "Hubble" space telescope is decommissioned.



Welcome aboard! Marco Fuchs, Dr Merkle and Jochen Harms welcome representatives of astrofactum in the OHB company family.

ExoMars: TGO orbit to become more circular

While preparations for the ExoMars RSP Mission (ExoMars Rover and Surface Platform Mission) in 2020 are running at full speed, the trace gas orbiter (TGO) for the ExoMars 2016 predecessor mission is conducting a series of complicated manoeuvres. Currently, the probe whose core module (MTP) was developed and built by OHB is still circulating within an extremely elliptical orbit whose furthest point from Mars is more than 20,000 kilometres above the surface. But an approximately circular orbit at an altitude of 400 kilometres is planned for the scientific phase of the mission to commence in 2018. This course is corrected by means of so-called aerobraking, whereby the space probe briefly dips into near space several hundred times, decelerating in the process. But it can not penetrate too deeply as it does not have a solid thermal shield. The entire manoeuvre will not be concluded until the end of March 2018.

MT Mechatronics involved in the SKA project of the century

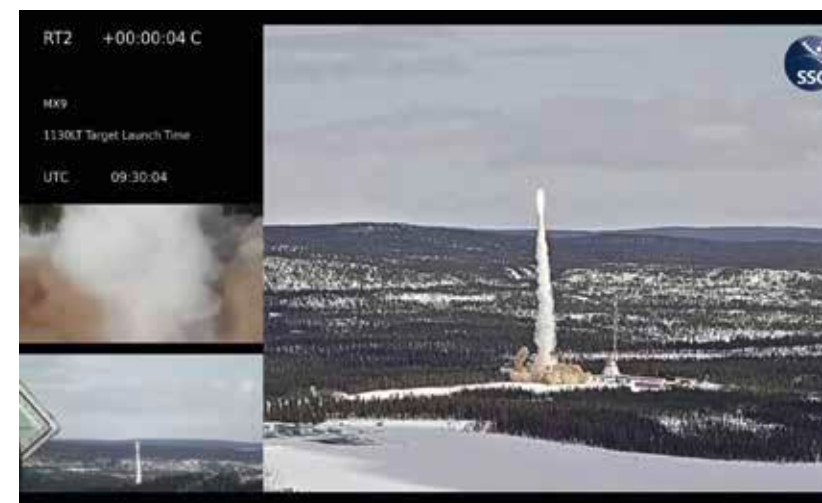


MT Mechatronics and the Max Planck Institute for Radio Astronomy in Bonn are co-developing a prototype antenna for the SKA (Square Kilometre Array) radio telescope project currently emerging. By 2023, the world's largest and most powerful radio telescope is to be built in the South African Karoo Desert and in the Murchis region of Western Australia, with a total antenna surface of 1 million square metres. Numerous countries and research facilities are intent on realising this project of the century for researching space. Ultimately, SKA will comprise thousands of antennae connected to super-computers for evaluating data via long-haul networks. The data volume will exceed the current level of international Internet traffic. The heart piece of the observatory will be represented by 15-metre parabolic mirrors in South Africa which are capable of detecting frequencies of 350 to 20,000 MHz. For this so-called SKA Mid-Dish Telescope System, MTM is collaborating with the Max Planck Institute to develop and build the prototype antenna which is to demonstrate its overall function in South Africa as of mid-2018.

Successful MAXUS-9 mission

On the morning of 7 April, the noise of a rocket being launched burst through the snow-covered landscape around the Esrange launch site near Kiruna in Northern Sweden. An unmanned MAXUS research rocket set off on its ballistic flight taking it to an altitude of 678 kilometres and exposing it to the conditions of weightlessness for a period of twelve minutes. This is the part of the flight that the researchers look forward to most as that's when the scientific tests and technology experiments are run inside the rocket. Once again, OHB System contributed to

the success of the mission in the form of key tasks. MAXUS is an ESA research project which has been running since 1990 with considerable involvement by DLR. OHB System has been involved since the programme was launched and is responsible for providing the service module and recovery system. The aerospace system house is also responsible for integration of the payloads and the environmental tests for take-off clearance. The OHB team also supports realisation of the missions at the launch site.



The Swedish Space Corporation had everything on its radar during the launch of the MAXUS-9 research rocket.

Endowed chair for more Sat-Com security



Since February, OHB System has been sponsoring the Junior Chair for "Secure Space Communications" at the Institute for Information Technology at the Bundeswehr University in Munich in an attempt to contribute towards developing efficient and safe communication links in today's information society. Dr Christian Hofmann assumed the Junior Chair in Neubiberg and will initially spend six years working on secure information transmission and information processing with a primary focus on aerospace applications. His research will also focus on securing radio signals.

Telecommunications for the world

Entering a new era with a pioneering spirit

We've enjoyed some exciting days recently. With the Hispasat 36W-1 satellite now circling the geostationary orbit, we have proven our advent in the demanding and promising market of telecommunications satellites. And this success is all the sweeter having evolved from perfect collaboration by several companies within the OHB Group.



The inhabitants of the Iberian Peninsula, the Canary Islands and South America have every reason to be happy: the Spanish telecommunications company Hispasat will be reliably supplying them with various multimedia services over the next 15 years.

This is made possible by the Hispasat 36W-1, a satellite which was launched on board a Soyuz booster at exactly 2:03 a.m. CET on 28 January from the European spaceport in Kourou. With a launch weight of three tonnes, the telecom satellite is now circling the Earth in its exact geostationary orbit at an altitude of 36,000 kilometres and reliably performing its service.

The employees in our group of companies have every reason to be happy about this. After all, this is the first satellite to be built based on the SmallGEO platform, co-developed by ESA, DLR and OHB System. At its peak, around 100 OHB colleagues were involved in the project. Accordingly, OHB Sweden contributed the

electric and cold gas propulsion system, LuxSpace is on board with its telecommand, telemetry & ranging system while OHB Italia supplied the control unit for the Tesat Spacecom payload. Our CEO Marco Fuchs rightly refers to the innovative SmallGEO project (see box) as a “type of family business”.

High level of concentration in the GSOC

100% concentration was displayed by those colleagues following the launch of Hispasat 36W-1 – 25 employees representing OHB System, OHB Sweden and OHB Italia who had collaborated with the DLR Team in the German Space Operations Centre (GSOC) in Oberpfaffenhofen to handle commissioning, steering and control of the satellite. In any case, they are sure to remember the moment when they received the first signs of life from their “baby” almost 40 minutes after the launch. And the relief they felt when it transpired that all systems were fully functional and the satellite had unfolded its solar wings as planned.

Almost two weeks after the launch, our colleague Nils Neumann reported what happened to the satellite in the days that followed: “It is monitored and supported around the clock. During its rest phases, it is watched over by ‘babysitters’ – five of them, just in case. And during its active phases, it keeps a 15-man OHB team on their toes. No effort is spared and everyone is fully concentrated. After all, there is one common goal: to gradually test the SmallGEO debut in orbit and prepare it for its future tasks. This means shift work at the GSOC and being ready at all times!”

And these weeks of tests and preparations have gone gratifyingly well. For example: the solar panels featuring a rotation mechanism and the two fold-out antenna reflectors (for covering Spain and South America) were easily extended. Likewise, the electric engines for the path corrections were easily calibrated and put into operation. The satellite was aligned exactly and the payload commissioned gradually channel by channel from low to high performance (outgassing). The satellite has even had its software updated. And finally, SmallGEO Project Manager Dr Dieter Birrek was able to report on 8 March: “Our satellite is working as expected.”

Major potential

This represents the dawn of a new era for OHB. “We have been enjoying international renown in this segment since successfully launching our first telecommunications satellite into space. We can now actively help to design the market and offer our technical solutions”, emphasises COO Andreas Lindenthal. And this market has a huge potential. Or as Magali Vaissière, Head of the ESA Telecommunications Department, puts it: “Satellite communication is the economic



Première: in the form of the H36W-1, the first geostationary satellite based on the SmallGEO platform is now in operation(1). SmallGEO team in the clean room at OHB in Bremen (2). The innovative electric and cold gas propulsion systems come from OHB Sweden. LuxSpace is on board with its telecommand, telemetry & ranging system while OHB Italia supplied the control unit for the Tesat Spacecom payload, for example (3).

SmallGEO

SmallGEO is the appropriate name for a small geostationary platform for communication applications. The system established as an independent line in the ESA ARTES-11 long-term plan is developed under the management of OHB System AG which was also responsible for the original project proposal. One key supplier is the OHB subsidiary MT Aerospace in Augsburg which supplies the xenon tanks.

What is special about the SmallGEO platform is its modular design, enabling the satellite to be individually fitted with the requisite functions in line with the demands of the respective client without requiring comprehensive modifications to the satellite bus. The advantages are obvious: short integration times make it possible to react swiftly to new market requirements and save costs. And the relatively low complexity displayed by the system ensures a high degree of reliability accompanied by a reduced programmatic risk.

Apart from its various areas of application in the telecommunications segment, the SmallGEO platform can also be used for Earth observation missions in the EO configuration. Accordingly, the MTG weather satellites are currently integrated on a SmallGEO basis at OHB System.

The ESA presents even more details on SmallGEO in this online video:

→ <http://bit.ly/2olmxZn>

motor in the aerospace sector.” According to estimates, around 20 geostationary communication satellites need to be replaced every year in order to maintain the current level of supply.

Around ten years ago, the area of geostationary telecommunications satellites was still a blank page for us. But since then, we have gradually acquired the corresponding system competence – initially in a proactive manner, then with the support of the DLR before finally convincing the ESA to include the development of small geostationary communication satellites in its ARTES programme.

This gives rise to a win-win situation for everyone involved: OHB has the opportunity to establish itself on a strong growth market, Germany regains its system competence in the area of telecommunications satellites after 25 years, and the operators can access increasingly more powerful and inexpensive satellites by means of added diversity and competition, whereby OHB fills the attractive niche of smaller and lighter satellites, achieving truly pioneering work in the process.

Hispasat 36W-1 is designed to withstand the tough environmental conditions in the GEO for a period of 15 years. Despite the sun storms and extreme temperature factors, path corrections must be exact to one-tenth of a degree to enable the satellite to broadcast its programmes in a stable manner. The successful

mission is now spurring on work at three other telecommunications projects based on SmallGEO:

► The second SmallGEO satellite **EDRS-C** is the next one to be launched in an effort to expand the European Data Relay System (EDRS). OHB System is the primary contractor for the chemically powered overall satellite whose integration in the clean room in Bremen has already progressed well. LuxSpace and OHB Sweden are also involved. The payload is supplied by Tesat-Spacecom. As the first telecommunications satellite in its class, EDRS-C is to be optimised in a special configuration for an optical payload. In the form of EDRS, a new standard of space-aided communication is to be achieved with higher data rates and secure transmission in real time. Latest ESA video:

<http://bit.ly/2q72mlH>

► Work on the German “**Heinrich Hertz**” satellite mission initiated by the DLR in cooperation with two ministries as a civil-military mission is already in full swing. In its capacity as an industrial primary contractor with many German partner companies, agencies and institutes, OHB has successfully concluded the O-B phases and been significantly involved in co-designing the concept for the entire system, including the ground stations. The communications satellite is to be launched in 2020, making key contributions to research as well as providing the German army with important communication services.



► The Electra Mission is to follow in 2022, for which an innovative platform variant with a fully electric drive has been developed since 2016, enabling the payload to be almost doubled despite the same satellite mass. This is what makes many different missions conceivable for a wide variety of clients. “In the future, we want to address the institutional and commercial market with one to two Electra satellites a year. Thanks to good collaboration with our project partners, we are already very well positioned for this today”, explains Alexander Schneider, Electra Project Manager at OHB System.

Guy Perez, the responsible Board member at OHB System, is full of enthusiasm as he describes work in the new Telecommunications Satellites Division: “Unlike other companies, OHB is capable of developing and building various types of GEO telecommunications satellites within a very short period of time, using both tried-and-tested and new technology, especially in the area of propulsion systems.” Key factors include the team spirit which is more distinctive and ambitious at OHB than in major corporations, as well as the wealth of ideas and flat hierarchical structure.

Meanwhile, OHB avails of the requisite experience to develop ideas on what future mission concepts could look like for German satellite communications systems, e.g. within the framework of the “SatCom2025” study. Mid-2016 saw OHB System establish the “Innovative Telecommunications Satellite Programmes” Department in an effort to further expand the division. This department is headed by Carsten Borowy who also monitors and analyses the trends on the market: “Classic broadcasting today is supplemented by the growing demand for streaming services where users can access offers at any time anywhere in the world. People are engaging in more global travel; the Internet of Things, linking everything with everyone, requires increasing capacity. Payloads nowadays need to offer far more functions. And all on the basis of increasing demands on data security and transmissions for our digital society. SmallGEO makes us fit for this task.”



On 28 January at exactly 2:03 a.m. CET, the Hispasat 36W-1 telecommunications satellite was launched into space on board a Soyuz booster (1). They have done a good job: the team at the German Space Operations Centre (GSOC) in Oberpfaffenhofen (2). In the form of EDRS, a new standard of space-aided communication is to be achieved with higher data rates and secure transmission in real time. (3)

Five questions for Torben Gille, Head Systems Engineer for Hispasat 36W-1

“We managed it thanks to our excellent teamwork.”

Torben Gille has been supporting the Hispasat 36W-1 project since early 2008 and was usually on site in the DLR satellite control centre in Oberpfaffenhofen for both launch and commissioning.



was well-prepared and able to make the right decisions fast. So, everything went hand in hand [...] the real relief came two days later after the first successful transfer manoeuvre.

Once again, OHB makes history with its SmallGEO. How does it feel to be right in the thick of things?

This feeling is rather secondary at this point in time. It evolves gradually as you have time to consider the process and enjoy the actual success behind it. We didn't just start working at full blast at the time of the launch – but rather several years prior to that. It was a very intensive time during which we often reached the limits of our own performance. But we managed it thanks to our excellent teamwork. I am very proud that we managed all of that!

What were the greatest challenges presented by this project?

The fact that it is the first GEO satellite for OHB and then so “small”, i.e. little space yet high performance, meant that we faced many new developments and a high degree of complexity. And the modification to the Soyuz booster only came four months ahead of the launch which involved handling additional challenges at the launch site, during the actual launch etc. But everything is now up and running and the payload has even been tested by up to 70 per cent (at the time of writing) in the orbit.

What are your next steps?

Next up is a sabbatical with plenty of relaxation and short trips as well as a trip to Australia and New Zealand. I have managed to accumulate so much overtime and OHB welcomes and supports this model of a sabbatical. But first of all, the satellite has to arrive at its final box in the GEO or at least be on its way there. Only then will I be able to take off with a clear conscience!

How does it feel at 3, 2, 1, lift-off when “your” satellite is being launched?

We had been working towards this moment for years so it goes without saying that it was something special, but our focus was definitely on the phase after separation, half an hour after the launch. There was a sense of heightened nervousness as it took a suspenseful ten minutes before the first signal could be received via one of the ground stations.

And when the first sign of life came, was there a great sense of relief?

Yes, definitely, but routine tasks still prevail as everyone concentrates on their work of commissioning and monitoring the individual systems step by step. And we had some major challenges to cope with, too. But the team



A NEW STAR IN THE SKY

What started as a small-scale school project is now being launched into its polar orbit as a high-tech satellite with New Space elements. Here's the impressive story of a nanosatellite called Max Valier that continually developed at OHB in the shadow of the major projects and, together, with Venta-2, now has exciting experiments on board.



The origins of this unusual project go back to a dinner in Bolzano, South Tyrol, early in 2008. Christa and Prof. Dott.-Ing. h.c Manfred Fuchs were visiting his former school, the Max Valier Technology Secondary School (TFO), and at a dinner with teachers and the school director Dr Barbara Willimek as well as representatives of the local “Max Valier” amateur astronomy group, they hit on the idea of supporting the school students in constructing their own real satellite as a school and study project that would be unique worldwide. Agreed with a handshake, the “Max Valier Sat” project then got underway. Prof. Indulis Kalnins, lecturer at Bremen University of Applied Sciences and consultant to OHB System AG, as well as Willem Bode, his student at that time, jointly took on the project on behalf of OHB. The two advisors often visited Bolzano TFO and together with students and teachers they developed the first ideas as to how the little school satellite might look. To begin with, they envisaged a simple model that would provide the basic features of a satellite. But this soon changed when Dr Peter Predehl of the Max Planck Institute for Extraterrestrial Physics (MPE) in Garching heard about this collaboration and, at the end of 2008, suggested an X-ray telescope as payload.

World's first amateur X-ray telescope

The idea for the miniature X-ray telescope μ ROSI was born. Its mission goal is a complete all-sky survey with

the aim of identifying at least 100 hot sources in the soft X-ray spectrum. Moreover, it will be the first mission to examine the Earth's horizon in X-ray light. The design of μ ROSI is derived from the famous ROSAT and a special aspect is that this time the data will not only be made available to scientists but also to hobby astronomers (see www.maxvaliersat.it). Although the telescope is just a factor-10 reduced version of ROSAT, it requires the same subsystems such as a mirror module for focusing the X-rays, a detector module for converting the radiation into electronic signals and an innovative thermal control system, developed by Dr Maria Fürmetz (MPE), for maintaining the specified temperature parameters.

Teamwork, hard work

So from this point onwards the Max Valier Sat project underwent a radical increase in complexity, because a telescope requires precise attitude control mechanisms in order to be able to exactly align and maintain its position in space. Reliable star sensors, momentum wheels, three magnetic torquers and a sophisticated electronics system for processing the extensive signals and data were all needed. An electronics teacher at Bolzano TFO, Prof. Ferdinand Heidegger, and his students mostly handled the main electronics system. Electronics and physics teacher Sandra Zuccaro and her students worked on the basic structure for the orientation and attitude control. Due to the increased



“People need a vision. You require creativity and confidence in your own abilities to make visions reality, and not to see them subside into unachievable utopias. Developing a real satellite influences the educational level of the vocational students and their technical capabilities.” Dr Barbara Willimek





"The satellite has grown into an international collaborative project with New Space elements. We were all highly motivated to promote this project that was and is so dear to the heart of the Fuchs family. Special thanks go to the OHB colleagues, especially to the team of the Bremen E-Laboratory, who always provided us with great support."
Prof. Indulis Kalnins.

complexity the attitude control became a real challenge, and this was subsequently optimised by specialists of the CS department of OHB.

At the same time, Willem Bode, now a project-managing system engineer at OHB, developed a casing for the nanosatellite that already integrated the electronics boards – a task that formed part of his bachelor's assignment. This compact structural solution allows for a significant weight reduction and saves a huge amount of space. The project team felt it would simply be a great pity to leave this capacity unused and so further experiments were taken on board. These share the casing, control computer, power supply and attitude control system with the Max Valier amateur radio satellite but bear the name Venta-2.

Hightech?

The additional experimental payloads come from all parts of the OHB Group and are the result of true team spirit. To give one example, the Swedish company ÅAC Microtec is testing the on-board computer for the MATS science mission which it is developing for the InnoSat microsatellite together with OHB Sweden. Moreover, ÅAC has contributed a newly developed TDRSS modem. TDRSS stands for Tracking and Data Relay Satellite System, which is used only by NASA and the US government to transmit data to the ground

from low-flying satellites via geostationary satellites, ultimately creating a faster and more complete process. OHB System is providing the "Software Defined Radio" technology experiment, which in contrast to conventional transmitters is not aligned rigidly to a narrow frequency band but instead can be reprogrammed and updated while in space. And the AIS receiver from LuxSpace for reception and processing of global shipping data almost rounds off the high-tech cluster. But only almost, because probably the most high-profile payload to be included in the Max Valier Sat/Venta-2 mission are chipsats from the once-in-a-lifetime project Breakthrough Starshot, initiated by Mark Zuckerberg, Stephen Hawking and Yuri Milner. In around 20 years the mini-format circuit boards will begin the voyage to Alpha Centauri and then search for cosmic neighbours there. The first prototypes are now to be tested on Max Valier Sat/Venta-2.

Following negotiations with several reputable providers, the combi-satellite is expected to go into space on June, 23rd on an Indian PSLV launch vehicle from Satish Dhawan Space Centre some 80 kilometres to the north of Chennai and hopefully will provide many impressive technological insights and valuable data to the ground stations in Bremen and South Tyrol.



Max Valier

This astronomer and author, born in Bolzano in 1895, is seen as a pioneer of rocket engineering. He studied astronomy, meteorology, mathematics and physics in Innsbruck and in 1924, with the help of Hermann Oberth, he published the book "The Advance into Space". The young pioneer experimented with various types of vehicle, thrust methods and fuels and achieved results that were sometimes revolutionary. Among other achievements, he constructed rocket-powered sledges and cars. During a test run for an innovative new rocket-powered aeroplane in Berlin in 1930 the engine exploded and Max Valier died at the age of just 35.

ALL ON BOARD

Some 20 satellites are flying on this mission. The main payload is Cartosat-2E, an Indian remote sensing satellite intended to help the urban and infrastructure development of the country. Venta-1, Latvia's first satellite, is also on board – realised by Ventspils University College as an educational project in collaboration with specialists of Bremen University of Applied Sciences and OHB System. The nanosatellite is equipped, among other items, with two AIS receivers from LuxSpace. Data reception takes place via the International Radio Astronomy Center in Ventspils, whose 16 m and 32 m radio telescopes were given a general overhaul by MT Mechatronics in 2015.

BIG DATA

Bolzano TFO and Meran have each set up their own ground station for the Max Valier Sat, operating on amateur radio frequencies. The call signs are IN3EAE (Bolzano) and IN3AIN (Meran).

The Max Valier Sat team at the Launch Readiness Review (from left to right): Prof. Indulis Kalnins (OHB project manager), Lara Taprogge (Bremen University of Applied Sciences), Markus Kluge (Bremen University of Applied Sciences/OHB), Iveta Kalnina, Elisabeth Heidegger, Dr Maria Fürmetz (MPE), Tobias Fabricius, (Bremen University of Applied Sciences), Ferdinand Heidegger (Bolzano TFO, electronics development), Peter Kofler (public grammar school & vocational secondary school for architecture, Bolzano Ground Station & Amateur Radio Beacon), Andreas Chizzali (Bolzano TFO, TMTC), Dr Barbara Willimek (Director of Bolzano TFO), Florian Kasslatter (Markas GmbH, sponsor), Christa Fuchs (OHB), Dr Peter Predehl (MPE), Arnold Gasser (Universal Srl, sponsor), Willem Bode (OHB project manager). Unfortunately some people were unable to attend the Launch Readiness Review: Sandra Zuccaro (attitude control), Manuel Zambelli and Simon Ebnicher (TMTC), Albert Cubet (OHB), Dieter Seiwald (Meran ground station) and Georg Caminada (CAM production).



Hunting the secrets of the cosmos

PLATO, JUICE, Solar Orbiter, Euclid – these names stand for some of ESA's most interesting science missions, which draw on our company's know-how.

What conditions are necessary for the development of planets and of life? How does our solar system work? How do the basic laws of the universe function? How did the Universe arise and what does it consist of? These are the four big questions at the centre of the "Cosmic Visions 2015-2025" programme of the European Space Agency ESA. And the OHB Group is involved in several of the missions selected to realise this programme. After already presenting "ExoMars" and "LISA Pathfinder" in previous editions, the focus is to be on four other scientific missions here.

The first major mission in the visionary ESA programme is called JUICE. That's a very appropriate name because JUICE is not only an acronym for JUPITER ICy moons Explorer, but also a suitable medium for quenching thirst – in this case the thirst of space researchers for knowledge about the icy Jupiter moons Ganymede, Callisto and Europa. And here's the biggest question for the researchers: is there life on one of the three targeted moons of the biggest planet in our solar system? Despite the large distance of these moons from the sun (some 780 million kilometres) this actually seems possible. After all, according to current insights there is liquid water flowing deep under the icy surfaces of the moons, heated by gravitational forces in their interiors.

Although Europa, for example, is smaller than our moon, it is likely to be home to more water than all of the oceans in the world. Some astronomers even think it is possible that there are fish frolicking around under its icy shell which is up to 15 km thick.

The JUICE probe, with eleven scientific instruments on board, will lift off in five years, will reach Jupiter eight

years later and then carry out detailed observations for at least three years. During this time it will pass close by Europa twice, among other things measuring the thickness of its ice crust and reconnoitring possible locations for future studies. Following an excursion to crater-rich Callisto it will then, in 2032, swing into an orbit around Ganymede to explore its magnetic field as well as its ice surface and internal structure, including the hidden ocean.

Involved right from the start

Our group of companies has been involved in the JUICE mission right from the start. ESA commissioned OHB, together with a French partner, to carry out a



OHB engineers during a project meeting

The European JUICE orbiter is to explore the three icy moons Europa, Ganymede and Callisto from 2030 onwards.



The Solar Orbiter will approach the sun to a distance of 45 million kilometres, thus coming closer than all other space vehicles previously sent out by mankind, even closer than Mercury, the planet nearest to the sun (1). Euclid aims to unravel the mysteries of dark energy and dark matter (2). PLATO will involve the use of 34 independent small telescopes and cameras (3).



"You don't need to be an astronaut to be enthusiastic about space exploration. So it's all the more exciting for us when our competencies are required for scientific missions."

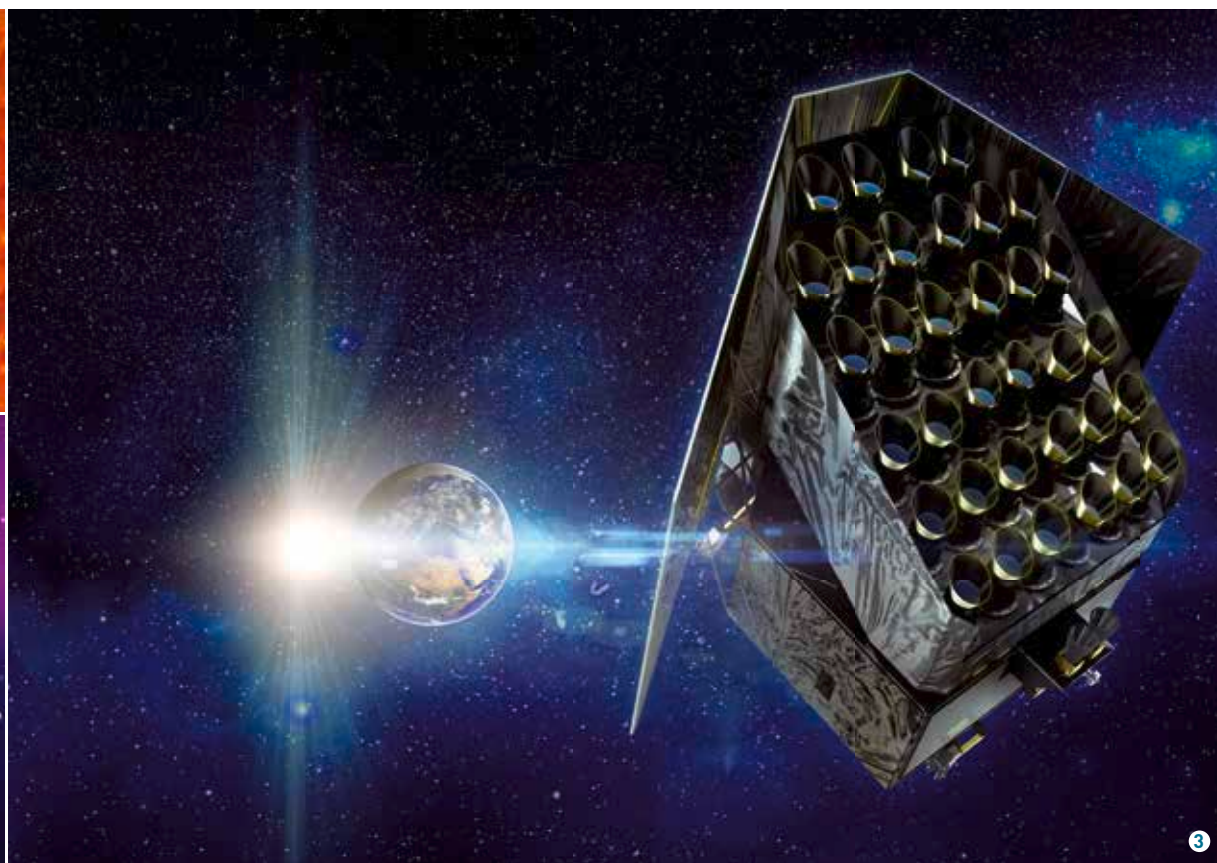
Dr Rolf Janovsky,
OHB System

feasibility study for the Jupiter Ganymede Orbiter (JGO), with which the properties of Jupiter and its moons Callisto and Ganymede were to be researched. In the end, ESA rejected the JGO concept because it was part of a planned joint mission with NASA, who eventually withdrew for financial reasons. But in this way the Europa Jupiter System Mission, intended to explore not only the gas giant itself but also its first four moons described by Galileo Galilei, morphed into the slimmed-down JUICE mission. As it also now includes the original NASA target Europa, volcanic Io is the only Galilean moon not included in the plan.

Antwerp Space is playing a major role in the JUICE mission. On behalf of Airbus Defence & Space, the Belgian colleagues are developing, integrating and testing the entire communications subsystem of the JUICE probe, which will secure the link with Earth. Like the subsystem that they are supplying for the ExoMars 2020 mission, this essentially comprises a deep-space transponder, X band and Ka band high-power amplifiers and the related Radio Frequency harness. Antwerp

Space is contracting out the construction and production of the individual components to various companies all over Europe. "We have now entered the phase where subcontractors are obliged to prove that their equipment offers the requisite performance", claims Project Manager Mattias Genbrugge. At Antwerp Space, all information is merged for the System Level Assessment to enable booting of the development of the ground test equipment. In just under a year, the engineering model is to be tested comprehensively in the company's new clean room.

Antwerp Space is also participating in the Solar Orbiter, the first Cosmic Vision project of the ESA category M, which stands for medium-sized missions; JUICE, as a major project with an estimated cost volume of around one billion euros, belongs to category L. The company (also in its role as contract partner of Airbus Defence & Space) is responsible for the tracking and command special Check out equipment. The Solar Orbiter will be lifting off in just one year and will then be investigating the surface and atmosphere of



ment of the largely autonomous attitude and orbit control system. Both systems should work perfectly together in order to perform highly complex flight manoeuvres. This is because the orbiter, in order to swing into its extremely close orbit around the sun, first needs to pass Earth and Venus several times to make use of their gravity.

Two years after the Solar Orbiter and two years before JUICE, the new ESA space satellite Euclid will begin its journey. It will use its telescope to hunt down the mysterious dark energy and the no less mysterious dark matter. Astronomers and astrophysicists all over the world are eager for this mission to begin because, although around 69.4 per cent of the universe consists of dark energy and 25.8 per cent of dark matter, we still know little about its properties. Euclid will measure the depths of space once more and observe how the gravity of the dark matter affects the galaxies and how the dark energy causes our Universe to expand ever further.

"This involves use of a near-infrared instrument for which the spectrometer and its complex, four-lens optical system was developed at the Max Planck Institute for Extraterrestrial Physics with the support of OHB Munich," explains Andrea Sacchetti, Deputy Director and Head of the Science Missions department at OHB in Oberpfaffenhofen. OHB Sweden is also involved, and is delivering the chemical propulsion system that will enable Euclid to correct its course on the journey to Lagrangian Point 2 as well as the fluid section of the micro-propulsion system, which is used for adjusting the satellite attitude.

Searching for a 'second Earth'

Our group is even more strongly involved in the ESA mission PLATO (Planetary Transits and Oscillations of stars). This received the green light almost three-and-a-half years ago, will be launched by 2024 at the latest and shall identify thousands of previously undiscovered exoplanets, only a few light years distant from Earth. While OHB System in Oberpfaffenhofen is supporting the scientific management of the mission led by the German Aerospace Center DLR and is leading development of the instrument, OHB in Bremen is responsible for the satellite definition.

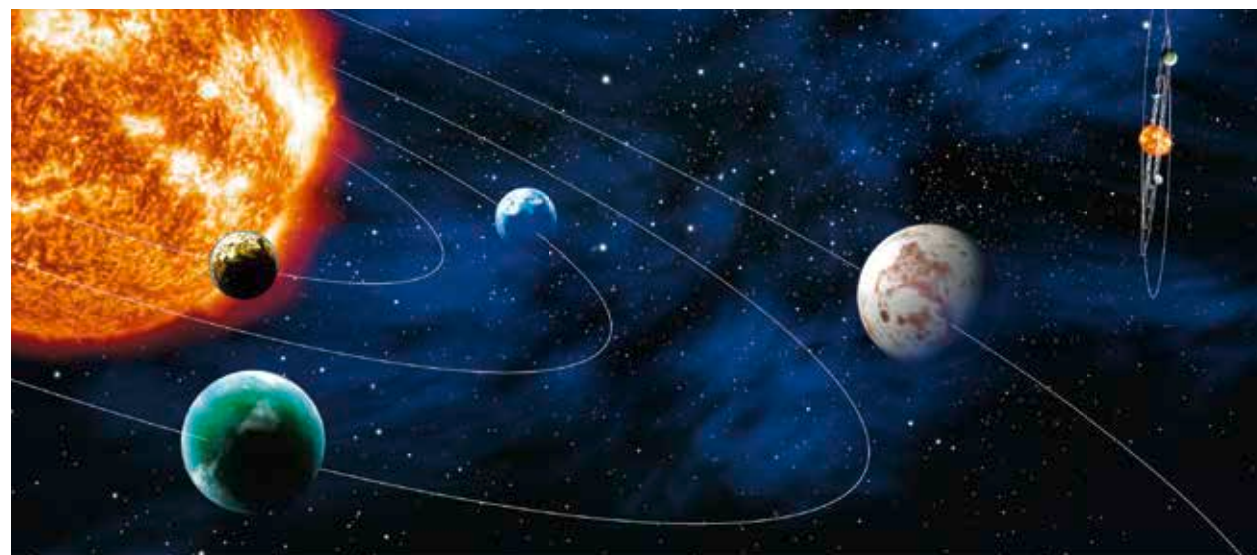
"It's remarkable that we received approval for our concept in October 2014. After all we threw our hat into the ring for the Phase B1 although we weren't involved in the Phase A. In the end, we were rewarded because we concentrated all our energies on the project and successfully completed the definition phase," says a pleased Dr Rolf Janovsky, who as Director at OHB System in Bremen is responsible for the early project phases. Now the company needs to put in a convincing proposal for the coming Phase B2/C/D as well, and thus to gain a major order of around 270 million euros.

the sun with its remote sensing instruments. This is expected to provide new insights into the solar wind, also known as 'space weather'. Besides Antwerp Space, two other OHB companies are involved in this mission: OHB Sweden and OHB Italia.

The Italian colleagues are leading and guiding an industrial consortium created for the construction of the Multi Element Telescope for Imaging and Spectroscopy (METIS). Here they are responsible for the general development of the instrument system and also have the task of the design and development of its optical and electronic subsystems. METIS is a high-performance coronagraph that will collect image data of the visible and ultraviolet emissions of the sun's corona, as well as fully mapping their structure and dynamics, with a spatial resolution never before achieved.

OHB Sweden is not only contributing the chemical propulsion system of the Solar Orbiter spacecraft, but is also the main contractor for the design and develop-





From 2024 onwards, the PLATO mission will track down thousands of planets only a few light years distant from Earth. Perhaps there will be an Earth-like planet among them.

PLATO will involve the use of 34 independent small telescopes and cameras. Positioned at Lagrangian Point 2, around 1.5 million kilometres from the Earth, it will scan about a million solar systems for tiny, regular brightness variations that are caused by planets passing in front of their suns. Parallel to this, on its six-year mission, PLATO will investigate the seismic activities of the planet-orbited stars and thus draw conclusions about their mass, radius and age, as well as working out the composition of the planets, if possible.

There's no doubt what the biggest prize would be: if the instruments were to identify a rather smaller but water-rich rocky planet with an oxygen atmosphere, orbiting in a life-friendly zone around a yellow star – in other words a kind of second Earth.

Here you can view a short video on several missions of the ESA programme "Cosmic Vision 2015–2025":

→ www.esa.int/spaceinvideos/Videos/2016/08/Space_science_everything_starts_here

Dream of the future: the M4 missions

Besides Solar Orbiter, Euclid and PLATO, the ESA programme "Cosmic Vision 2015–2025" includes a fourth medium-sized scientific mission. OHB companies are currently involved in the definition of the three possible missions among which the M4 mission will be selected:

- The **THOR** (Turbulence Heating Observer) mission, in which OHB acts as system leader, would help to clarify a phenomenon in plasma physics: how plasmas heat up in the Earth's magnetic field as well as its interactions with the solar wind.
- **ARIEL** (Atmospheric Remote-Sensing Infrared Exoplanet Large survey) would use a 1-metre telescope to investigate the chemical composition and the physical state of the atmospheres of some 500 extrasolar planets. This would probably also increase our knowledge of how planets come into being at all. OHB System is acting as subcontractor.
- OHB is also involved on a subcontractor basis in the space telescope **XIPE** (X-ray Imaging Polarimetry Explorer). If this were to be built, it would research the X-ray radiation from high-energy sources such as supernovae, galactic jets, black holes and neutron stars.

104

satellites were put into space by India using its PSLV (Popular Satellite Launch Vehicle) on 15 February, setting a new record in the process.

750,000

objects more than a centimetre in size are currently orbiting the earth according to ESA. Since their average speed is around 27,000 km/h, a collision with a satellite would release roughly the same energy as an exploding hand grenade. Some 18,000 of these pieces of wreckage are so large that they can be tracked by high-performance space monitoring systems.

1,000,000

square metres is the area of the antenna of the world's biggest radio telescope (Square Kilometre Array, SKA), which is planned for the Karoo Desert in South Africa and the Western Australian region of Murchis. MTM is developing the prototype antenna and building it jointly with the Max Planck Institute.

2,298

workers were employed by OHB SE on 31 December 2016. This is 242 more than a year previously.

1,560 million euros

was the order backlog of OHB SE on 31 December 2016. The greatest part of this, namely 1,341 million euros, was accounted for by the "Space Systems" division.

65 metres

high and 8.40 metres in diameter: these are the dimensions of the fuel tanks for the main stage of NASA's Space Launch System (SLS) – and with a capacity of almost 1,000 tonnes of liquid water and oxygen, they are no less than 30 per cent bigger than the giant external tank of the earlier Space Shuttle. MT Aerospace is developing and manufacturing the correspondingly large aluminium segments of the NASA heavy-lift launch vehicle.

50 years

of the European Space Operations Centre (ESOC) are being celebrated on 8 September. The control centre of the European Space Agency ESA, which opened in Darmstadt in 1967, is responsible for the operation of all ESA satellites and for the accompanying worldwide network of ground stations.

60

years ago, on 4 October this year to be precise, the first artificial satellite "Sputnik" was launched into Earth orbit. The ball-shaped device, with a radius of 58 centimetres, a weight of 83.6 kilograms and equipped with two radio transmitters, stayed in space for three months before burning up on 4 January 1958.

High-five:
from a five-man
operation to
among the top
three in European
aerospace



OHB System is celebrating its birthday. A good 35 years ago, Christa Fuchs made a decision which was to prove innovative. Over the following pages, we take a look back on unusual roots, some fateful decisions and the speedy development of OHB.



On 4 December 1981, Christa Fuchs joined Otto Hydraulik Bremen as a partner. At the time, this small 5-man operation was building and repairing hydraulic and electric systems for the German Navy. A year later, the then 44-year-old assumed corporate management of OHB, hired Ulrich Schulz as its first qualified engineer and set the course for growth.

But things could have happened entirely differently as this Hamburg-born entrepreneur was really only looking for a new challenge. Her children had left home, her husband Manfred was a successful manager at MBB ERNO and retirement was a long way off. At the time, the qualified businesswoman even toyed with the idea of acquiring a wool shop in Bremen's Roland Shopping Center.

The fact that we are not among the top three on the international knitwear market today is attributable to a chance encounter at a CDU party event in Bremen where Christa and Manfred Fuchs heard about the Otto Family which was looking for a successor for its small hydraulic business, OHB. The businesswoman thought "Why not? Then let's fit ships instead!", and bravely accepted the offer at short notice. Our current Supervisory Board Chairwoman started off with a small yet robust workshop in the Hemelingen area of Bremen.

Always exploring new paths

Also in 1982, the young engineer Ulrich Schulz was invited there for an interview. "I drove past the business a few times as I didn't think it could be just a garage entrance. I was certain I was at the wrong address and was just about to turn around again", is how our current Management Board Member describes his first impressions, grinning. The fact that he thankfully engaged in the OHB "adventure" was due to a meeting with Manfred Fuchs who outlined his plans for the company's future with "an incredible vision and infectious enthusiasm". He too was considering joining his wife in self-employment. ERNO was undergoing major changes and the South Tyrolean was finding the company increasingly rigid and bureaucratic.

After meeting Manfred Fuchs, Schulz' free spirit was soon convinced that he'd "be able to do new and really interesting and crazy things here. His plans for the company were so exciting. He wanted to start off with a creative group capable of getting things moving, a flexible and innovative company with around 200 people. But he wasn't making any promises. He spoke openly and honestly about how casual it would all be, particularly at the start."

Step by step towards space

And that's the way it was. But first of all, Schulz, the engineer who had previously worked in an aerospace technology company, had to get his head around the subject matter of "ships". "I crawled all over the place, slept on board and had every detail explained to me", is how the 66-year-old describes the initial phase. This was followed by orders for hydraulic drives, subsystems for environmental vessels through to construction of the "Knechtsand" oil recovery vessel as a primary contract.

Parallel to this, initial aerospace plans were tackled as of June 1985 when Manfred Fuchs joined the company. The respected ERNO manager took the chance of joining his wife's business as he was more familiar with the aerospace business than practically any other, having helped to significantly develop the sector in Northern Germany. He saw niche areas which he would be able to serve with a smaller and more flexible business, and firmly believed in his ideas and visions. Step by step, the business developed from research drop capsules, through falling object trial systems and payloads for the D2 and MIR 92 & 97 space flight missions to numerous participations in the Columbus research module for the International Space Station (ISS).

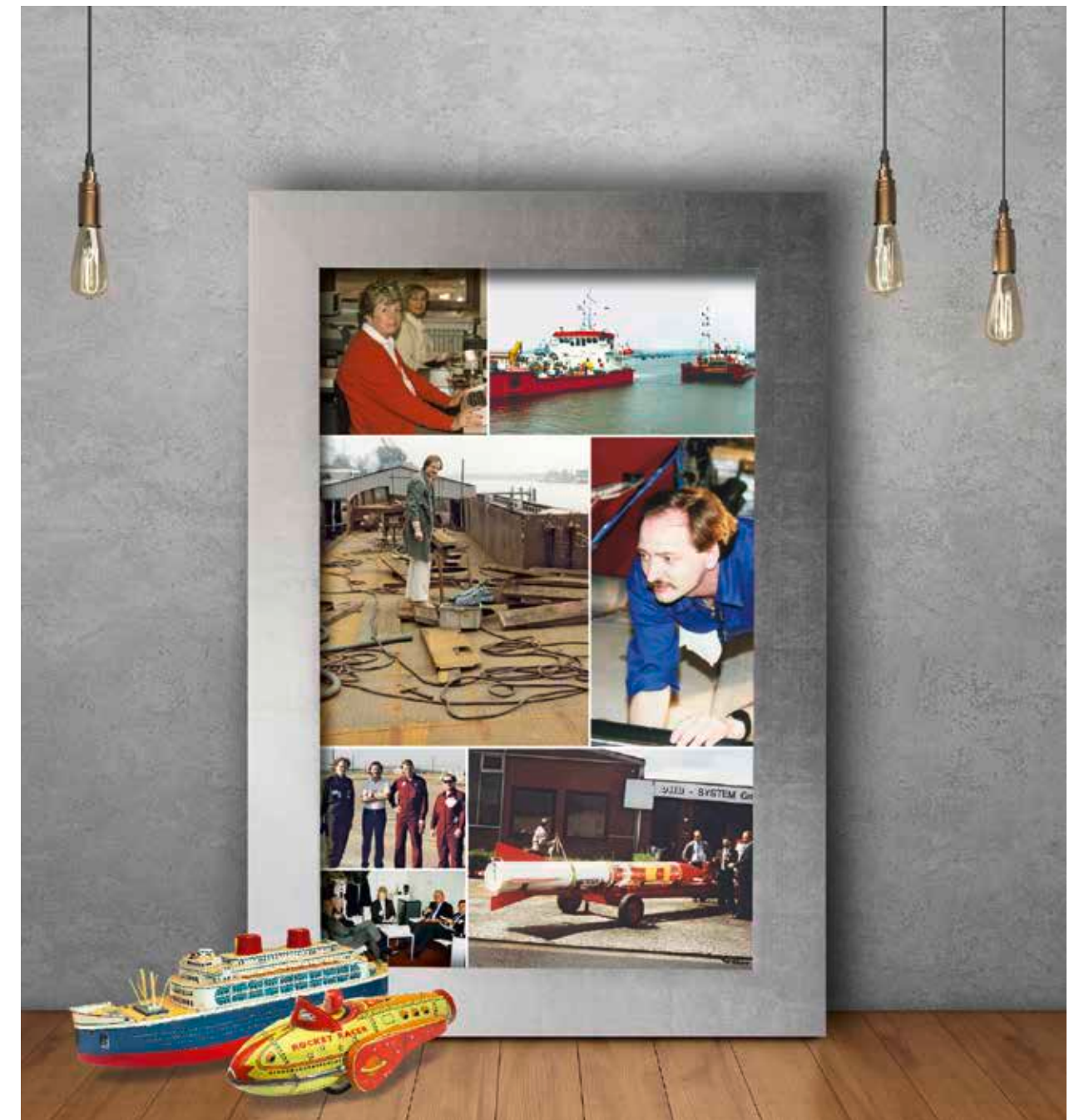
For Schulz, this meant disembarking the ship and boarding a plane in order to research micro-gravitation during parabolic flights, for example. Over the years, OHB has established a reputation in this area as well as in the area of small satellites – ranging from subsystems for the Envisat environmental satellite, through its own Safir 1 and 2 productions to construction of the BremSat science satellite in the early years of OHB. "This wide range of projects meant that we soon relieved ourselves of any inhibitions we may have had about trying out entirely new things", explains Schulz.

What the young company lacked in experience and documented heritage was compensated for by extremely creative, unconventional and customised approaches in its offers. And this was supplemented by uncomplicated and swift decision routes within OHB.

In the mid-1990s, for example, Ulrich Schulz announced his interest in developing the telematics division for which he would relinquish his 80-man development area. Within a mere three hours, everything had been reorganised and the news was relayed that same evening at the Christmas party.



Top: As early as 1995, Manfred Fuchs received the "Entrepreneur of the Year" award from the German Association of Self-Employed Entrepreneurs after only ten years of OHB. Bottom: Reinhard Stelljes scales the antenna construction built by OHB for the test installation of the Mikroba mission in 1998.



Christa Fuchs (top and bottom left) acquired the small OHB business in December 1981. Ulrich Schulz (centre and 2nd from left on the apron beside our colleague Dirk Glander) was its first engineer. The early years were characterised by shipbuilding, parable flights, fall capsules, a hands-on mentality and a pioneering spirit.





Additions to the OHB family

Telematics and a few other lucky coincidences also led Marco Fuchs to join OHB in the mid-1990s. Working as a lawyer in New York and Frankfurt at the time, he did not originally have any plans to return to Bremen and join his parents' high-tech company. But thanks to restructuring plans at his law firm, the young lawyer's working environment became increasingly rigid and unattractive which was why he elected to join his parents as their future successor.

With Marco Fuchs, the technical visionary Manfred and his financial expert wife Christa were flanked by a strategist who swiftly set the course for further growth. Starting with the IPO in 2001 in which Uli Schulz was also significantly involved. That same year, the OHB "underdog" clinched the order for the SAR-Lupe radar satellite reconnaissance system. Not least thanks to Dr. Fritz Merkle, one of the so-called "fathers of the SAR-Lupe", who had joined the company in 2000 with his experiences and connections

in the military sector. "The German Army demonstrated a great level of confidence in us for which we remain grateful today. After all, SAR-Lupe enabled us to impressively prove our overall system competence", claims Christa Fuchs.

Meanwhile, her son Marco was realising the Europe-wide growth strategy step by step in the form of strategic corporate acquisitions with the aim of attributing our OHB Family a broader basis with complementary business areas. 2005 saw MAN Neue Technologie (now MT Aerospace) join the group with its many years of experience, serial production, long programme run times and Ariane business. This was followed by Kayser-Threde (now OHB System in Oberpfaffenhofen) with its scientific payload competence, Luxspace, OHB Sweden and OHB Italia with their documented expertise in the area of micro- and mini-satellites as well as the ground segment experts at Antwerp Space.

Film tip Filmed blueprint for Star Wars

When the sci-fi blockbuster "Valerian and The City of A Thousand Planets" hits the cinemas in mid-July, then many are sure to think that a whole lot has been copied from "Star Wars". Well, they'll think wrong!

It's true that the parallels in visual aesthetics can hardly be overlooked, but only because George Lucas was actually the imitator when he first created the *Star Wars* myth in 1977. In fact he borrowed generously from the comic series "Valerian und Veronique" which is now serving as source material for the European space stunner. The first



volume of the Franco-Belgian cult series, created by Pierre Christin and Jean-Claude Mézières and telling the story of two young space-time agents from the 28th century, was published back in November 1967. In the film by French director Luc Besson ("The Fifth Element") the two heroes are played by Dane DeHaan and Cara Delevingne.

→ www.valerianmovie.com

Into the Net Three worth- while clicks



The real-time 3-D card "Stuff in Space" shows satellites, rocket bodies and pieces of wreckage in Earth orbit and identifies them as well.

The website, programmed by the Texan student James Yoder, is updated daily with orbit data from

Space-Track.org and uses the satellite.js library. Scientists of the Free University of Berlin have produced an impressive video that simulates a flight over the roughly 600 km-long valley Mawrth Vallis on Mars. Here they have used high-resolution images taken by the Mars Express as well as a digitally calculated terrain model produced at the DLR Institute of Planetary Research. The short 17-minute film is startlingly professional, even though it was created by the *Star Wars* fan Shawn Bu as the final assignment for his bachelor's degree. It's really worth seeing, and also includes thrilling lightsabre fights between the sinister villain Darth Maul and several Jedi knights.

→ www.stuffin.space

→ www.dlr.de/dlr/desktopdefault.aspx/tabid-10333

→ www.youtube.com/watch?v=DJo_91jN3Pk

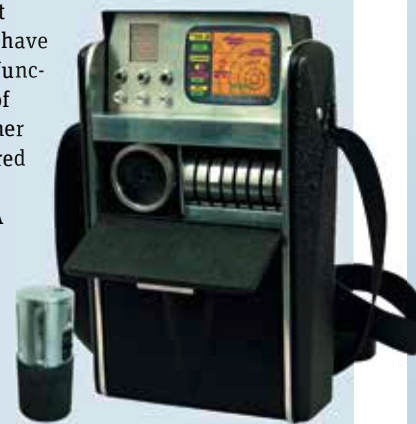
Just like in Star Trek "Tricorder" senses GM technology

One of the most fascinating devices used by the "Enterprise" crew under the leadership of Captain James T. Kirk in the 23rd century is the "tricorder".

The little box that in the original series looked like a cassette recorder from 50 years ago (see photo) is able, thanks to its 200 or so sensors, to collect and analyse countless physical and medical parameters. Now researchers led by biologist Prof. Scott Egan at

Rice University in the USA have developed a device with a function strongly reminiscent of this wonder gizmo: a scanner that identifies GM-engineered organisms by using its spectrometer to reveal DNA anomalies with the help of nanoparticles. Egan freely admits: "The tri-corder was an inspiration for what we aim to do."

→ www.rice.edu



Book tip Fascinating retrospective



Our colleague Andreas Dierks of OHB System in Oberpfaffenhofen recommends to us the 350-page book "Infinite Worlds: The People and Places of Space Exploration".

Here's his review: "The American photographer Michael Soluri accompanied the very last Hubble Telescope Service Mission, which was carried out by the crew of 'Atlantis' (STS-125).

His impressive pictures show the astronauts, engineers and technicians who managed to capture the Hubble telescope as it flew free in Earth orbit, to repair it and to release it back into orbit. In the process they replaced subsystems that were never intended for removal at all, much less in space. In short essays, some of the ground crew, Hubble engineers and astronauts describe their motivations and passions, without which such a mission could never achieve success. All in all, this is a fascinating retrospective on one of the most spectacular Space Shuttle missions and on the people and places behind the mission."

→ www.simonandschuster.com

Team profile

Making the Fly Eye dream come true

OHB Italia has patented a key technology for tracing potentially hazardous celestial bodies. A team headed by Lorenzo Cibilin has developed an innovative telescope which emulates the compound eye of a fly.



They formed the first core team in the “Fly Eye” project (from left): Marco Chiarini, Piero Gregori, Lorenzo Cibilin, Francesco Cerutti and Roberta Pellegrini. They were later joined by Luca Cavalli, Fabrizio Duo and Franco Belloni (not illustrated).

It's not easy to discover an asteroid which poses a risk for life on Earth. The skies are too large and the renegade pieces of rock are too tiny from a distance. You'd need to have the eyes of an insect, capable of seeing in several directions at the same time, in order to reliably monitor such an extensive field of vision. And that is exactly the basic idea on which the “Fly Eye Team” at OHB Italia is successfully working.

Commissioned by the Italian aerospace agency ASI and the European Space Agency ESA, the Italian OHB subsidiary has developed a “fly eye telescope” for timely detection of approaching near-earth objects (NEO). To this aim, it has been at the helm of an alliance of research institutes, universities as well as small and medium-sized companies since 2009.

The original team of five has meanwhile been supplemented to form a core team of eight Milanese colleagues at OHB Italia (CGS until the end of last year): Project Manager Lorenzo Cibilin, Optical engineer Marco Chiarini and Mechanical Engineer Piero Gregori are members of the System Engineering Board while Roberta Pellegrini and Francesco Cerutti oversee responsibility for AIT (Assembly, Integration and Test), and Luca Cavalli is responsible for software design with Fabrizio Duo supporting Franco Belloni in Analysis and Verification (FEM/FEA).

Innovative ideas

CGS was awarded the contract for the NEOSTED (NEO Survey Telescope Deployment) ESA project in 2015 but initial development work had already commenced five years previously. Project Manager Lorenzo Cibilin can well remember how things started off back then, when intensive discussions were held on how to apply the principle of the compound eye to astronomy in order to generate as large a field of vision as possible.

“The basic idea for the ‘fly eye telescope’ originated from Professor Roberto Ragazzoni at the National Institute for Astrophysics INAF but was further developed by OHB introducing the new concept of ‘infinite frame’, resulting in an industrial product. In fact, in order to realise it, we were obliged to explore several areas of new terrain”, reports the 59-year-old Project Manager. Accordingly, his team developed an entirely new telescope architecture with 16 identical optic channels which combine to generate an enormous continuous field of vision spanning 44 square metres. “Thanks to innovative image processing techniques, our system can even

extract significant pixels from the practically contourless noise background which could indicate the presence of an asteroid”, adds the 45-year-old engineer, Piero Gregori.

But the telescope also integrates many more new ideas. One particular success has involved simplifying many components, reducing the production and provision costs in the process. “This applies to the spherical mirrors, lenses with their reduced dimensions and modular optical channels, for example”, clarifies the 49-year-old engineer, Marco Chiarini.

Coming up with such solutions is a major feat in itself involving multidisciplinary coordination within a major research alliance. The consortium led by OHB Italia includes Creotech from Poland, Toptec from the Czech Republic, Hitec from Luxembourg, Enviroscope and ProOptica from Romania, Actemium Cegelec from Germany, Emil Lundgren from Norway as well as Anafocus and Ixion from Spain. Academic support was provided by the universities in Padua and Pisa, the INAF and CNR-ISTI Institutes, and the Politecnico in Milan.

High level of motivation displayed by everyone involved

“Bundling these various competences from the areas of physics, astronomy, materials science, optics, engineering and optoelectronics, and ensuring dynamic collaboration by everyone involved was the greatest challenge we faced”, emphasises Lorenzo Cibilin. But a shared visionary goal ensured a particularly high level of motivation across the board. “We set ourselves the challenge of making the Fly Eye dream come true”, states Cibilin.

Just how well this collaboration worked in practice is obvious on the basis of the result: the Fly Eye Team has successfully concluded the entire innovation process from a research object through to a patented modular industrial product. And now the Milan-based team is impatient for the next major practical test. “In only two years’ time, the first prototype in the full FoV configuration is to commence work at the breathtaking location of Monte Mufara in Sicily. Another one will then be commissioned in the Chilean Highlands”, muses Project Manager Cibilin. And the next step will be to build the European SST Ground Optical Observation Network, initially comprising 21 “Fly Eye Telescopes”, at sites around the world.

Cibilin and his team are proud to be supplying the key technology for this network which the ESA hopes to develop within the framework of its Situational Awareness Near-Earth Objects System (SSA NEO) programme. After all, the fact that its system can be used to scan the entire visible sky three times a night could very soon be a decisive factor in preventing Earth's inhabitants from being hit by a devastating asteroid impact.

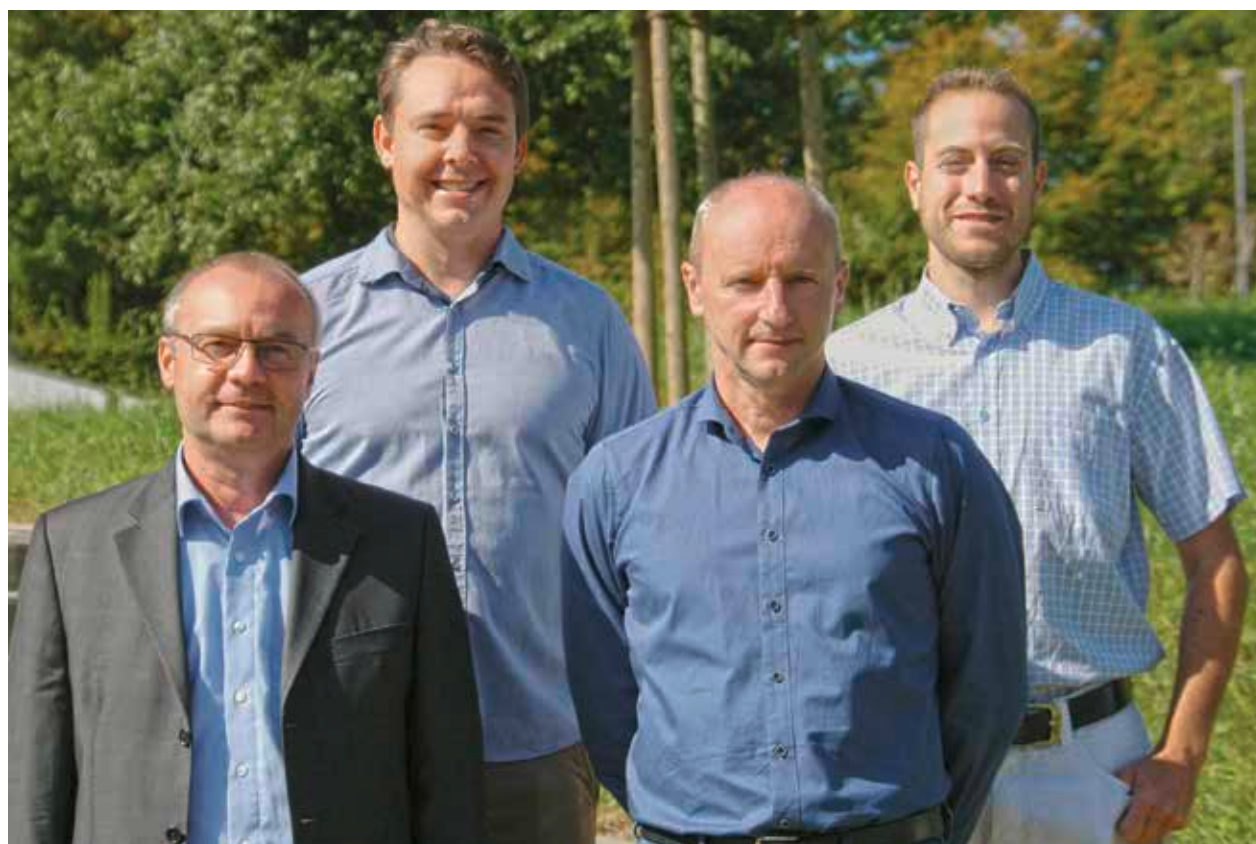


Wide Survey

The optical “Fly Eye Telescope” developed under the management of OHB Italia plays a key role in the ESA Situational Awareness Near Earth Objects System (SSA) programme. Fitted with 16 interlinked optical channels, it combines the advantages of an extremely expansive field of vision and very high image resolution and, thanks to its modular design, can also be produced and maintained comparatively inexpensively in large piece numbers. There are plans for an SST network of up to 21 “Fly Eye Telescopes”, each of which will scan the entire visible sky in the LEO belt. In terms of the NEO field, complementary to the “Deep Survey” approach, the observation strategy applied for this “Wide Survey” approach should make it possible to discover threats by Near-Earth Objects (NEO) at an early stage, enabling prevention and mitigation measures to be taken in time. Over the next three years, 100 million euros will be available for the SSA programme pursued by the ESA.

Keeping watch on the oceans

13 million AIS data, representing the global maritime traffic of major commercial fleets, are received by LuxSpace every day. It's a huge and valuable data machine, kept running reliably and with ongoing development by the team led by Dr Gerd Eiden, head of the department of Applications and Services.



The LuxSpace AIS team from left: Willibald Croi, Luc Späth, Dr Gerd Eiden and Miguel Nuevo

This information is of great interest to many commercial and institutional customers. The data can bring clear improvements in the directing of maritime traffic and in safety and environmental protection on the world's oceans. This is why the European Maritime Safety Agency (EMSA) recently concluded a service contract with LuxSpace for a further four years, sup-

porting the agency's work within the European Union by providing access to this global information on some 130,000 ships at sea every day.

LuxSpace has been doing business with the AIS data since 2009. "AIS is a theme that's central to the company as a whole. We are an authorised reseller of the

ORBCOMM satellite services, we ourselves have built micro-satellites that receive AIS signals, such as Veselsat 1 + 2 and the future Triton-X as well, and we have the requisite IT infrastructure and the know-how to market the services," says Dr Gerd Eiden, who together with his team handles this central component of the Luxembourg-based space company. The team comprises the geo computer scientist Miguel Nuevo, who is responsible for the software domain, and thus for database maintenance and for process and app development. A vital issue here is to prepare the data formats in line with customer wishes. In order to ensure that the fully automated service runs smoothly, the IT infrastructure must function correspondingly round the clock. And this is the task of IT manager Luc Späth in the team headed by Willibald Croi and Dr Gerd Eiden, who continue to expand business operations relating to the AIS data and to develop ideas for new applications. "We consider where potential customers may be found, what they need, and then we make them a corresponding offer," explains department manager Eiden (age 54).

The team mainly concentrates on developing new processes and further expanding the existing AIS services. To this end it collaborates closely with OHB Logistic Solutions, among others, which is specialised in tracking and monitoring containers. But when these containers are loaded into the hold of a cargo ship for transport they become almost invisible. This is where the AIS service provided by LuxSpace comes into play. With these data, the customer not only knows where his goods are currently located on the high seas but also, and much more importantly, he knows exactly when they will arrive at the port of destination and so can optimise his logistical chain accordingly.

One project particularly close to Eiden's heart is an observation system for sustainable fisheries, being developed by LuxSpace with the support of ESA and the World Wide Fund for Nature in collaboration with the Munich-based company navama. "Consumers are becoming ever more critical and they want reliable information about where their fish comes from and who caught it using which method," says Eiden. His team has developed an app that lets the information be checked precisely using AIS data and provides the consumer with this and other product information. "We are involved in discussions with several large retailer chains and tuna-processing companies about offering them our service for greater transparency and traceability. But things are difficult, especially in the fisheries sector, despite all the calls for more sustainable fishing. Sometimes we're simply too early with our offers," says Eiden, who already knows that the potential customers are above all to be found in Germany, England and Italy.



"Traceable back to the catch": the fish was caught in the North Sea, around 150 km north of Bremerhaven, on 14.11.2014. The white line shows the sailing route of MS Annegina and the precise location of the catch, as well as the port of landing Harlingen in the Netherlands.



Here's the QR code:
Just scan and get information on seeFish

What is AIS?

The Automatic Identification System (AIS) is a radio system installed on large mercantile and passenger ships that continually transmits numerous static and dynamic ship data for, among other things, identification, position and navigation.

Link to AIS animation:

→ https://www.youtube.com/watch?annotation_id=annotation_1153908803&feature=iv&hd=1&src_vid=gtffmxjmehs&v=CP-TcDtSFDI



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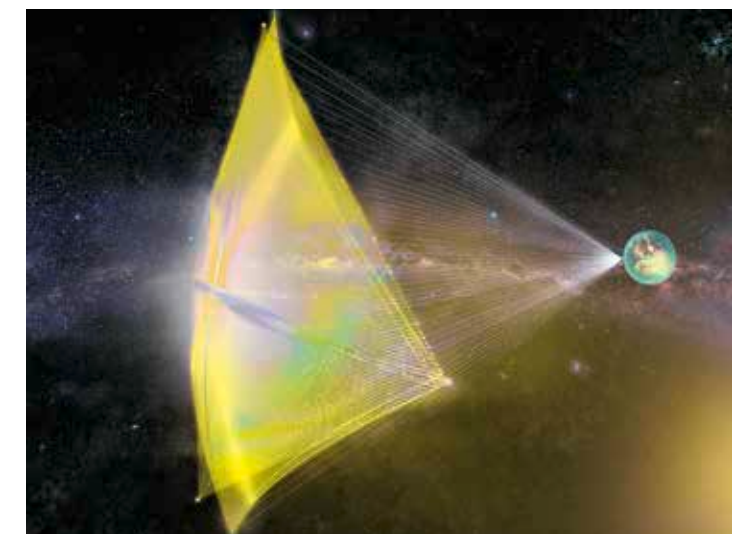
In the USA, numerous companies and young start-ups are causing a major stir in the classical space sector under the catchword “New Space”. The trend is gaining momentum. OHB is responding with its own Venture Capital company and invites all creative minds to submit their own business idea.

New Space is often associated with factors such as commercialisation, private investment, innovative technologies, unconventional approaches and close links to the IT sector, as revealed by a recent study by the Federal Ministry of Economic Affairs and Energy, entitled “New Space – Opportunities for Germany”.

But in fact this term is not as new as the name leads one to believe. The concept first appeared in the US market back at the start of the 1980s, with the founding of the private space companies Orbital Science Corporation and SpaceHab Inc. The movement really took off after the dotcom boom in early 2000, which made Internet entrepreneurs such as Elon Musk and Jeff Bezos into billionaires and enabled them to found their New Space start-ups SpaceX and Blue Origin. Both companies build relatively cheap rockets, significantly reducing the costs of transportation into space and setting off a domino effect. Satellites are easier to replace if they don't work properly and the satellite builders achieve return on investment more quickly. Labour-intensive and cost-intensive qualification procedures on the ground are reduced to a minimum or can be dispensed with entirely. In many areas, technology development and one-of-a-kind production are making way for commercial off-the-shelf components. Thanks also to microelectronics, satellites are becoming smaller, lighter and cheaper. This not only helps to reduce the insurance costs for launches, which are sometimes huge, but also allows hundreds of satellites to be carried into space. More affordable access to space has opened up the market to new, innovative and unconventional business models and customers.

“Mega-constellations on mini-, micro- and nano-satellite basis (‘CubeSats’) are the icons of the New Space scene. They have the potential for wide-ranging com-

mercial applications, especially in earth observation, for broadband links and for the Internet of Things,” is one conclusion of the New Space study. It should be realised that the American framework conditions such as rapid legislative changes favouring the New Space movement, as well as the “think big” mentality with the willingness to invest a major part of one's personal fortune in things like one's childhood dream of settling on Mars (Elon Musk), cannot be applied to the European market on a 1:1 basis. Nonetheless, spaceflight is definitely undergoing major global development and, in important subsectors, is reinventing itself.



The idea behind Breakthrough Starshot: chip-sats with solar sails are accelerated to 20 per cent of light speed by the thrust of impacting light particles projected by phased-array lasers. This propels them on their 20-year journey to Alpha Centauri.



Innovative concepts

Ulrich Schulz, our Management Board member for Technology, New Space and IT, focuses on the opportunities for the OHB Group resulting from these developments. He too assumes that New Space will establish itself above all in the telecommunications and earth observation segments in Europe. "But certainly not in manned spaceflight. Lives are at stake here, and you can't calculate these with risk factors," he stresses.

"The New Space approach has a lot in common with what we started back then. SAR-Lupe was basically the first New Space project that we undertook here, but at that time the term still hadn't become so popular. The client gave us plenty of room for creativity. Developing and realising five satellites including ground station and launches with economical Russian rockets for a little over 300 million euros – that was certainly unusual. The industry was pretty amazed! The same goes for Galileo. Aspects of this project are New Space as well. Now we're gaining momentum and are testing the waters for our group of companies," continues Schulz.

To give one example, OHB has already submitted tenders for very large satellite constellations. Short application periods of just a few weeks are a special characteristic of the competitive process in the New Space sector. Ulrich Schulz draws a positive conclusion: "Despite our huge growth in recent years we are still smaller and more flexible than our big competitors and we retain our ability to create unconventional and technically innovative concepts. That's an advantage that we also need to apply in New Space activities!"

Expanding the horizon

OHB not only has a reputation in the sector as an established space systems company, but also continues to be seen as an innovative trendsetter. A view confirmed by a collaboration with what's probably the most ambitious of all New Space projects: Breakthrough Starshot! This initiative aims to send thousands of tiny chip satellites, hardly bigger than postage stamps, to the neighbouring binary star system "Alpha Centauri" using solar sails. The idea is to bridge the impressive distance of 4.37 light years in just 20 years. To achieve this, the mini-format space-



SpaceX (Elon Musk) is stirring up the space transport market with the Falcon rocket (1). Virgin Galactic aims to develop private space tourism (2). Blue Origin's New Shepard is still relatively small. By 2020 Jeff Bezos aims to have a giant reusable rocket called New Glenn on the market that will eclipse SpaceX (3). The long-term goal of all three companies: flights to Mars!



"SAR-Lupe was basically the first New Space project that we undertook here, but at that time the term still hadn't become so popular."

Ulrich Schulz

ships need to reach 20% of light speed. Breakthrough is donating 100 million dollars to enable development of the required technologies, such as high-powered lasers and foil with a thickness of just 100 atoms.

As Chairman of the Breakthrough Prize Foundation, the former Director of the NASA Ames Research Center, Pete Worden, is also involved in the project. Our Chief Executive Officer Marco Fuchs met him last year at an asteroid conference in Luxembourg, and they were both immediately enthusiastic about each other's enterprises. This was followed by a visit to the OHB headquarters in Bremen this April, and by the agreement that OHB would support the mission. Some of the little ChipSats – albeit still without solar sails – are already in the Bremen clean room and were launched using the Max Valier nanosat to show, as a first step, that they function. "What fascinates me about Breakthrough Starshot is this ambitiousness to make changes using small things. Expanding the horizon in the truest sense of the term, undertaking the search for habitable planets. Pete Worden immediately felt that we fit well into the concept after I had presented some of our projects and approaches," says Marco Fuchs.

Generating new growth

But Breakthrough is only one of the many initiatives and possibilities that New Space brings. Dr Fritz Merkle, our Management Board member responsible for Strategy, Business Development and Marketing, explains why New Space is so exciting and important for OHB. "The years of strong growth are over for the time being. We are now in the consolidation phase, while simultaneously New Space is changing the sector and bringing many new players into the market. There will be a further phase of commercialisation in the space sector. Megaconstellations for telecommunications and earth observation, strong growth in applications,

the themes of exploration and raw materials, new launch concepts... Even the old theme of space tourism is gaining new impetus. We are keeping a very close watch on these developments and are now working to generate a fresh growth phase through new business ideas, new approaches and innovations in both technical and entrepreneurial terms. We have what it takes!"

OHB is underlining its ambitions in this area with the founding of its own Venture Capital company. "We are already established as a supplier of space systems with great creative potential, and now we aim to play an important role in the New Space sector, too. That's why we support promising ideas from the word go," says Marco Fuchs.

OHB Venture Capital GmbH wants to invest worldwide in start-ups and companies that fit the New Space sector and the strategy of the OHB Group. "The range of support we provide includes venture capital, our solid know-how, mobilising our contacts in the research and funding sector, and even involves help with entrepreneurship," explains Jochen Harms, Managing Director of OHB Venture Capital. "We act as a corporate venture and we generally focus our investments on start-ups that can later be integrated into the OHB companies. Here, we aim for a majority interest, of course," continues Harms.

Business foundation initiative

However, OHB VC supports external start-ups as well as employees of the OHB group with suitable business ideas. For further information please get in contact with Jochen Harms at

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