

Facts and insights

#### TOTAL REVENUES EUR 1,001 million EBITDA

#### EUR 99 million

EBIT

# EUR 63 million

#### EMPLOYEES

**3,025** from more than 35 nations

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## Unlocking the SECRETS of the UNIVERSE

A spirit of discovery, curiosity, a thirst for knowledge and the need to keep pushing the boundaries of what has already been achieved: These were the driving forces behind the first epoch of practical space. Triggered by the space race between two competing nations in the 1960s, huge investments were made and efforts taken to venture into new realms for the first time. The activities during that period created the basis for further developments that have brought us to where we currently are in less than 100 years. These days, exploration missions are being planned for ever remoter destinations. To this end, the space industry is in the process of designing the necessary infrastructure together with more powerful launch vehicles that can take people to the Moon and, looking further into the future, to Mars and back again. In addition, ambitious science missions such as the James Webb Space Telescope, which was launched last year, are providing not only new insights but also stunning images that are capturing the general public's imagination. The OHB companies are contributing their skills to the science and exploration programs outlined below in order to broaden humankind's knowledge and, in particular, to better understand the universe.

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Marco R. Fuchs, CEO



# drives US

#### GREENER, MORE SECURE AND MORE CONNECTED

Environmental and weather satellites

**Reconnaissance satellites** 

Space safety missions

Telecommunications and navigation satellites

CURIOUS AND ASPIRING

Science and exploration missions

ACCESS TO SPACE

Microlauncher

Launcher components, tanks and structures

#### **RESOURCE-EFFICIENT FLYING**

Aero engine components

#### ESTABLISHING SECURE CONNECTIONS

1775-161

Telescopes, ground systems and satellite operations

Cybersecurity, encryption and railroad infrastructure

#### UTILIZE FULL POTENTIAL

Data analytics, applications and professional services At the core of everything we do is space. We utilize it to find answers to the complex questions of our time – we have always aligned our activities to this ambition.

With our space system solutions, we are addressing the growing demand for space-based data, which is being fed by current and future challenges such as the effects of climate change, natural disasters and national security. We enable or support the management of the growing complexity and interconnectedness of all areas of our lives through our system solutions in space and on Earth as well as through our digital solutions. Our participation in various launch vehicle programs, which are helping to secure access to space, forms the basis for finding the answers to these questions.

In this way, we are contributing to a greener, more secure and more connected world, now and in the future.

# What moves US



Marco R. Fuchs Chief Executive Officer



The science budget is traditionally one of ESA's largest budgets.

#### OHB can look back on a significant track record of science and exploration missions – what current or earlier mission particularly stands out in your mind?

**Marco Fuchs:** The multiple objectives of the missions have resulted in new knowledge in very different areas. For me personally, our current PLATO project is extremely significant. This is a probe that will be searching for extrasolar planets from 2026. The payload of this space telescope will consist of 26 individual cameras, making it the first instrument capable of finding Earth-like planets in the "habitable" zone of sun-like stars.

#### What connection do you see between science and exploration and OHB SE's recently announced purpose "We utilize space to find answers to the complex question of our time"?

**Marco Fuchs:** Obviously, the standards we set for our activities apply in full to this area in particular: With our expertise, creativity and experience, we are making it possible to amass a basis of data, i.e. we are creating knowledge and enabling insights that can render hidden connections visible and thus provide a basis for making deductions.





Kurt Melching Chief Financial Officer

You have published a very precise outlook for the three most relevant financial performance indicators covering the period until 2026 – what is your intention in doing this? Kurt Melching: Our medium-term forecast is based on an extensive array of data, which is checked for plausibility by managers in various areas. Given our very good track record in meeting our profitability indicators, we see no reason not to publish the status and forecast metrics.

#### What is the greatest challenge when it comes to managing finances?

**Kurt Melching:** For the most part, we work on long-running customer projects where payment flows are not consistent. In addition to optimizing profitability, we need to monitor and manage liquidity in our day-to-day business. This has become even more challenging, especially in the recent past given such factors as the Covid-19 pandemic, supply chain disruptions and high inflation.



**Dr. Lutz Bertling** Member of the Management Board responsible for strategy, corporate development and digitization

#### During the last ESA Ministerial Conference, the science and exploration budgets amounted to EUR 3.2 billion and EUR 2.7 billion, respectively, over the next three years. What is your take on these figures?

**Dr. Lutz Bertling:** These very high figures once again reflect the strong interest that the European nations have in these matters. The science budget is traditionally one of ESA's largest and played a dominant role during the Conference of Ministers again. As far as OHB is concerned, this is opening up further potential in terms of both technology and business, particularly following the favorable progress made on the PLATO project. Exploration is the second largest budget and, given humanity's quest to return to the Moon, I expect to see further increases at the next few conferences. In particular, OHB is in an excellent position with respect to the envisaged European capability of landing robots on the Moon. And ultimately, these are missions that can attract talent to space. This, too, is important for us and for Europe.



#### Let us now leave the SPACE SYSTEMS segment and move on to the DIGITAL segment: What current activities have the greatest potential for generating sales growth in the medium term?

**Dr. Lutz Bertling**: I see very strong growth potential for the DIGITAL segment in three areas in particular: One is what we call "digital twins", which we can use in climate protection, but also in critical infrastructures, to replicate and optimize systems and simulate changes. Then there is the use of Earth observation data for climate protection, improving productivity in agriculture and fisheries and the like. The third area concerns safety-related applications in the broadest sense. These range, for example, from cybersecurity for the digital railways and secure autonomous mobility to detecting breaches of rules at sea. However, our traditional fields such as satellite ground systems or satellite operations will also benefit from the growing importance of space in all our lives and thus from the rising number of satellites.

Our size allows us to offer our employees a wide range of individual opportunities for personal development.



Klaus Hofmann Chief Human Resources Officer

#### The employment market has seen major changes in the last 5-10 years – to what extent have potential job applicants' expectations of employers evolved and how do you respond to them?

Klaus Hofmann: Their expectations have indeed undergone a radical change. In addition to highly attractive remuneration and related benefits, what is becoming increasingly important is the sense of purpose and the sustainability of the business model, maximum flexibility in terms of working hours and location (mobile working) and a feel-good workplace. This includes the structure of a company's internal environment that promotes encounters and exchanges with coworkers, individual workplace equipment, catering and on-campus activities. In addition, we are constantly working to leverage our potential as a medium-sized company with an international footprint: Our size allows us to offer our employees a wide range of individual opportunities for personal development while ensuring that they do not lose sight of the immediate value of their own contributions. We complement this potential by offering attractive personnel development programs.

#### What areas of the space industry are typically of particular interest for job applicants – are science and exploration among the most sought-after areas?

Klaus Hofmann: Obviously, science and exploration rank very highly in terms of applicants' preferences. Broad-based discussion across society about the challenges posed by climate change as well as the steady rise in the global population, with all the associated consequences, has made Earth observation just as attractive for potential employees. Heightened global awareness of the potential that space offers for shaping the future is creating strong interest on the part of employees to work in this area.



Daniela Schmidt

Member of the Management Board responsible for sustainability, integrity, legal affairs and corporate security We want to establish sustainability as a decision-making criterion in our everyday actions, plans and thoughts.

#### You have been a member of OHB SE's Management Board since the beginning of last year and have set up the Sustainability unit since then – what goals do you want to achieve in this area this year?

Daniela Schmidt: In 2023, we are placing a clear emphasis on transparency. We will be stepping up our progress toward achieving our goal of having a Group-wide database for environmental and social issues. In this way, we are creating the foundations for identifying the main levers and for defining effective measures. We are also continuing to focus on organizational structures and transformation. We want to establish sustainability as a decision-making criterion in everyday thinking, acting and working. To this end, we will continue to engage in dialog with stakeholders both internally and externally and establish broad acceptance. We have already started this but want to communicate it more effectively in the future.

#### When it comes to internal processes, what approaches offer the greatest leverage for positive change as a basis for becoming a more sustainable company?

**Daniela Schmidt:** The data we currently have indicates potential for reducing energy consumption, for example, in our cleanrooms, and for making mobility more sustainable. We will be leveraging the findings from our project on the life cycle assessment of our products to identify further scope for enhancing the sustainability of our products. Beyond this, however, it is also important for us to ensure that our activities make the greatest possible contribution to sustainability for others.

## Happy The International Space Station ISS is turning 25 BIRTHDAY

In February 2008, the Space Shuttle Atlantis lifted off from Cape Canaveral, Florida, bound for the International Space Station ISS. On board was the European research laboratory Columbus, which docked with the ISS three days later. OHB is the only European company to be involved in the development of all the scientific research facilities for the Columbus module and played a key role in the first biological experiment as well as many others for the European space research laboratory. OHB has put a lot of effort into cabling Columbus, particularly its infrastructure.

#### Knotted and wired: ISS infrastructure from Bremen

OHB assembled the entire cable harness for the electronic test module. Each module contains around 1,700 connectors with over 12,000 contacts as well as 33 different types of cables with a total length of over 30 kilometers. The harnesses were produced and both parts subsequently tested in OHB's Columbus clean room in Bremen. The name is therefore no coincidence, as OHB founder Prof. Manfred Fuchs (deceased) is one of the people who gave the Columbus module its name.

In October 2007, the second node for the ISS was successfully placed in orbit by US Space Shuttle Discovery. Named "Harmony", it included harnesses and secondary structures, internal scaffolding and racks also supplied by OHB in Bremen. The node is the module which links the ISS laboratories. The first one is called Unity and has been in operation as the second part of the ISS since December 1998. The nodes provide access to the connected laboratories and also contain living, stowage and storage space.

Node 2 has interfaces for the European Columbus laboratory and the Japanese module, as well as a docking station for

#### Our contribution to a piece of space history

t 25, you (usually) finally feel all grown-up, you've had your first experiences in life, both good and bad, and your best years are still ahead of you. Celebrating its 25th birthday this year, the International Space Station ISS can look back on a wealth of research experience in weightless conditions, contributing things that make life on the Earth better as well as paving the way for our efforts to embark on missions to the Moon and Mars in the future. Some 400 kilometers above our heads, traveling at a speed of around 28,000 kilometers per hour, a whole host of OHB technology and knowledge has been hurtling through space on board the ISS since its launch on November 20, 1998 - just ten months after the international agreement was signed by all ISS partners. And since birthdays provide a great opportunity for revisiting the past, we would like to take you back to 2008, the year in which the European Columbus module was being readied for its voyage into space.

ge | Our mission

November 1998 International Space Station ISS launched February 2008 Space Shuttle Atlantis launched to carry the European research laboratory Columbus to the ISS 2024 Launch of first modules for the "Gateway" lunar station

January 1998 International agreement signed by all ISS partners October 2007 Second node for the ISS launched October 2014 European-Russian ISS research facility "PK-4" launched

the Space Shuttle. The internal structures were developed by OHB and built by companies in Bremen and surrounding regions. They mainly contain the power and data distribution and life support systems (air treatment/cooling/heating/fire suppression) for the enlarged ISS in its final stage of development and for a crew of seven astronauts. The cable harnesses developed and engineered at OHB include conventional copper lines for power supplies and data as well as fiber optic cables for online image data transmission.

OHB was also responsible for providing the cabling for the Automated Transfer Vehicle (ATV), which was used for supply and disposal tasks on board the ISS.

Yet, this is far from being OHB's sole contribution to the ISS. The first medical research laboratory EPM (European Physiology Module), which went into operation in the Columbus module on board the ISS, was also engineered by OHB. The EPM, which was developed and built for the European Space Agency ESA under the guidance of OHB's Human Spaceflight department, went to work on the question as to how weightlessness affects the human organism.

In 2014, the European-Russian ISS research facility "PK-4", in which OHB's microgravity department at the Oberpfaffenhofen site is playing a key role, was successfully launched on its route headed for the ISS. As a permanent research facility in the European research module Columbus, "PK-4" provided new insights into complex plasmas.

To ensure that the fun in conducting experiments on board the ISS was never neglected, OHB also repeatedly qualified equipment for use in space. Examples include the Myoton-PRO muscle measuring device that Alexander Gerst used to measure muscle tension in zero gravity and the EMS training suit worn by Matthias Maurer to perform physical exercise during his mission.

#### Between pride and the question "What comes next?"

Needless to say, there have long been plans for a new station to orbit the Moon: Known as the "Gateway", it is expected to be launched in separate modules from 2024 at the earliest. With a view to the future, the ISS partners are currently working on plans for this next major milestone. The lunar orbital base is to become a stepping stone for astronaut missions to the Moon or Mars. OHB is involved in planning the European module known as ESPRIT (European System Providing Refueling, Infrastructure and Telecommunications), which is to be built under a contract for the European Space Agency ESA.

Back to the future: We are eagerly waiting to find out when the Gateway will go into operation as its development will incorporate an immense volume of knowledge acquired on board the ISS, and we hope that, by the time it celebrates its 25th birthday, we will be able to look back on just as many OHB projects.

How does weightlessness affect the human organism? Physical exercise is part of an astronaut's daily routine. ESA astronaut Frank De Winne (Belgium) was the first crew member to use the "Flywheel" physical exercise device developed and built by OHB. Use of the Flywheel helped to overcome the problem of muscle and bone atrophy faced by astronauts. hat was once considered to be science fiction is becoming reality in modern space. Chasing comets and looking into distant solar systems may sound pretty far-fetched at the moment. But it is far from being that. The OHB Group is making a crucial contribution to the PLATO mission, which will be searching for exoplanets in other solar systems, as well as the Comet Interceptor, which is to visit an unknown comet. This article explains what the two missions are all about and when OHB technologies will be embarking on their journey into the unknown.

With Comet Interceptor, the European Space Agency (ESA) is planning to analyze a previously untouched object from the beginnings of our solar system. The purpose is to gain new insights into the origin of the universe. OHB Italia is the prime contractor responsible for executing the mission. OHB System and OHB Sweden are also involved as subcontractors. The contract awarded to OHB Italia is worth around EUR 117 million.

Working as a team, the OHB companies will be completing three probes over the next few years. They will subsequently be placed in a waiting position once the mission commences in 2028. The main probe is to be positioned in such a way that it is located close to the comet as it flies past. What comet this will be has not yet been determined and will most likely not be known when the mission is launched.

#### Lagrange point L2: The perfect parking spot

As it is not possible to predict with sufficient lead time when a suitable target object might enter our solar system and the construction of a spacecraft is a lengthy process, the probes will be built independently of the emergence of a particular object and parked in space so that they can wait. This will be at Lagrange point L2. Once a suitable target appears, the probe is configured to complete a maneuver to intercept the target.

L2 is an attractive parking spot because its orbit makes it particularly stable, meaning that few course corrections will be necessary. Seen from the Sun, L2 is about 1.5 million kilometers "behind" the Earth. This makes it a good place for Comet Interceptor to wait, as the transfer to the actual target can be executed from there at the appropriate time. The amount of propellant carried on board will allow the probes to remain at L2 for about four years.

Overall, the mission will consist of three spacecraft: the primary probe and two smaller secondary ones. With this configuration, it will be possible to complete measurements at several positions simultaneously. Each of the three probes will carry a suite of instruments permitting detailed investigations of the sun's effect on the comet. Spreading the

How Comet Interceptor and PLATO are unlocking the secrets of the universe

file



instruments across three different spacecraft has the added advantage of allowing the main probe to maintain a greater distance from the comet. This is important because the dust particles surrounding the comet move at extremely high speeds. Speeds of over 70 kilometers per second relative to the probes are expected, meaning that, despite their small size, these dust particles have sufficient energy to pose a threat to the probes.

Research into comets is interesting in many different ways: Comets are remnants from the early days of our solar system and therefore carry information from which scientists can obtain clues as to the origins of the solar system.

#### The PLATO mission and the question as to whether there might be life in other solar systems

ESA's PLATO (Planetary Transits and Oscillations of Stars) mission is also dedicated to the big questions surrounding the formation of our solar system. PLATO is a satellite-based observatory for use in space to detect and study exoplanets. Exoplanets are located outside our solar system and are thus subject to the gravitational pull of other suns. OHB System is the prime contractor for PLATO under a contract worth EUR 288 million.

PLATO is to explore fundamental questions. Scientists are hoping to find answers to questions such as: How are plan-

ets formed? And how do they change over time? Is our solar system unique? What are the properties of Earth-like planets in the habitable zone around stars? And, indeed, PLATO will also indirectly help to answer the age-old question as to whether life might exist in other solar systems.

"PLATO will not only detect but also study extrasolar planetary systems. The primary focus will be studying the properties of terrestrial planets in the habitable zone around sun-like stars," explains Andrea Sacchetti, PLATO project manager. "In addition, PLATO will be studying seismic activity in the interior of stars, as scientists hope this will shed light on our own sun, including its age."

#### How PLATO will detect unknown planets

Once PLATO reaches its target orbit at Lagrange point L2, the payload consisting of a total of 26 cameras will be pointed at stars in front of the dark universe. The cameras will be able to detect very small and regular changes in the light that occur as planets pass in front of stars, briefly dimming some of the starlight.

OHB is currently building the structural and avionics model. This year, the structural model is due to undergo the environmental test campaign, successful completion of which will mark a major milestone for the project team. In terms of time, the project is also on schedule, with the launch planned for December 2026.

Structural and thermal model of a PLATO camera in a thermal vacuum testing chamber.

#### Why do we need exploration missions?

Exploration and science missions into the far reaches of outer space could provide clues to help us answer the big questions facing humanity. One of these arguably goes to the very core of our being: Are we alone in this universe or is there other life out there? In addition, past missions have consistently produced benefits for people's lives on Earth. New technologies for space can often perform important pioneering work for humanity.

»PLATO will not only detect but also study extrasolar planetary systems.«

# The fascination of the MOON

With the initial launch of the lunar Space Launch System, OHB technology made in Augsburg will be bound for the Moon

Space Launch System on launch pad 39B at the Kennedy Space Center in Florida

he Moon has always held a special fascination for astronauts as well as space fans and enthusiasts. When you look out of the window at night, it sometimes seems to be so close you could almost reach out and touch it. Its proximity to the Earth also makes the Moon an excellent starting point for missions into the far reaches of outer space. With the NASA-led Artemis program, humans will soon be setting foot on the Moon again and perhaps even using it as a stepping stone for voyages to distant worlds. One of the components of the Artemis program is the large lunar launcher – the Space Launch System (SLS) – for which OHB's Augsburg-based subsidiary MT Aerospace has built and supplied tank components for the main stage made of a special aluminum alloy. MT Aerospace is working under a contract for Boeing.

So, when the SLS lifted off on its maiden flight from the Kennedy Space Center in Florida on November 18, 2022, OHB was also celebrating, as the two dome caps sealing the 742,000-liter liquid oxygen tank as well as the two dome caps for the 2-million-liter liquid hydrogen tank had been engineered by the OHB Group's Augsburg-based launcher experts. The launcher placed an uncrewed Orion space capsule into a lunar orbit. Over a period of several weeks, the capsule flew around the Moon before it was placed on a course back to the Earth and eventually steered into the Pacific Ocean. MT Aerospace's participation in the SLS project is a big deal: It is the most powerful launcher ever built, enabling astronauts and payloads to be transported on NASA's Artemis missions to the Moon – and even as far as Mars. The fact that the solid technology "made in Bavaria" is a sought-after component in a major NASA program could prove to be a door-opener for other key U.S. projects according to Petra Wiegard, the project manager for SLS components at MT Aerospace: "Humanity's route back to the Moon is now also bearing MT's signature."

Petra Wiegard explains exactly what this signature looks like: "The SLS requires strong thrust to overcome the pull of the Earth's gravity at launch. The main stage, which is the second stage to fire, is a powerful generator of thrust. It consists of cylindrical tanks, each of which is sealed off at the top and bottom with dome caps. These dome caps, in turn, are made of 2.5 x 3-meter Gore panels, which are curved aluminum components manufactured and tested at MT Aerospace in Augsburg." As far as the company is concerned, the contribution to the SLS is first and foremost a team effort: "We have demonstrated first-class team spirit, involving quite a few theorists and practitioners in addition to the SLS core team. I look forward to continuing to work in and with a strong SLS team!"

And this work has long since commenced: Looking forward, MT Aerospace will also be supplying high-performance tank components for the EUS (Exploration Upper Stage), which will enable astronautical exploration missions. The components are expected to be used from Artemis 4 onwards and are currently in production.

# EXPLORATIONOf DUCKOf DUCKO

origins of our EXISTENCE the universe around us work and our purpose in it. After all, space is the greatest mystery we have yet to fathom and is fascinating in many aspects. Among other things, researchers are studying questions such as: Is there life on other planets? How did the universe come into being? What do other worlds look like? Exploration answers some of these questions and simultaneously keeps asking new ones. We need to believe that there is important and relevant knowledge out there.

#### So does that mean that one day we will be living on Mars?

I hope so, albeit with the addition of the word "also". It will take time before life there is possible. Before that, however, a human being will certainly pay a short visit to Mars. I am convinced that life on Mars will be extremely different from life on Earth. Maybe we will just use it to save the human species – a type of Noah's Ark, so to speak. And maybe this will just be the beginning. Yet, all beginnings are difficult.

#### Mars, Venus or the Moon – if you could book a package tour to one of these planets, which one would it be?

Definitely Mars. We have less gravity there, a reasonable flight time of one-and-a-half years and maybe there is ice and snow there for "skiing".





Venus is too hot for me, and its atmosphere is even worse than on Mars. The Moon would be an interesting alternative for me. Maybe there will soon be package tours that combine the Moon and Mars, as a cruise, so to speak. That would be a very interesting itinerary for me.

#### When will we see the first commercial space stations on other planets, and what influence will they have on future exploration missions?

You can never be sure with a prediction like that. First of all, we must implement cost-effective transportation using reusable launchers. So, if one day we can protect ourselves effectively from radiation exposure in space and build closed-loop life support systems, this vision will surely become a reality. This latter aspect in particular is interesting. How are we supposed to live on a space station without water and oxygen? This calls for a highly sustainable solution from which we can certainly learn a lot for life on Earth. Let's put it this way: I hope that I am young enough to experience this. I was born in 1963.

#### The age of space began with exploration. In the 1960s, the U.S. and Russia devoted massive amounts of resources to winning the race to the Moon. Can we pick up where we left off there with the U.S. Artemis program?

The race between the nations in the 1960s was very politically motivated. We now have a different situation. Even so, NASA's Artemis program wants to put humans back on the Moon to test technologies for future voyages to Mars. Unlike in the 1960s, several nations are now cooperating and working jointly on long-term goals. Looking back, I always find it interesting to see how much progress was made in the 1960s. I hope that we will build on this with Artemis.

Speaking of the United States, you worked for a long time in a very responsible position at SpaceX. In terms of your motivation, what was stronger: Developing a cutting-edge new launch vehicle or the vision of enabling multiplanetary life?

My motivation changed over the nearly 20 years that I was with SpaceX. At the beginning, I asked myself whether we could develop a launcher from scratch with a team of 200 people - only governments and large companies had managed that before. Our answer was: Yes, we can. Later in my career, the projects dedicated to Elon Musk's vision of creating multiplanetary life became more interesting for me. Elon has a plan to make it possible for millions of people to live on Mars by 2050. I am fascinated by this idea. I have a passion for exploring life's big questions.

#### What do you say to the objection that we humans should first take care of our own planet and protect the Earth before striving for distant worlds?

These two aspects are not mutually exclusive. I see this in terms of different time periods. In the last 500 million years, there have been five major mass extinctions due to natural events such as the impact of an asteroid, volcanic eruptions and the like. A multiplanetary humanity, spread across distant worlds, would be immune to this as a species. This, of course, is critical for the continuation of the human species and civilization. We should also keep in mind that everything we learn about distant worlds helps us to deal more effectively with the problems facing us on our home planet as well. Our knowledge can be put to use in technologies that generate cleaner energy, produce better food and generally create less waste. Exploration also offers intangible added value: The first lunar landing was a source of inspiration for many people and brought us together as humanity. I think that landing on Mars would have an even greater impact.

#### What future event in space are you personally looking forward to?

There are a number that I'm eagerly awaiting – full spacecraft reusability, returning to the Moon, the first commercial space station, and so on. Yet, the really big thing would be the first person on Mars.



Shortly after being elected to the Supervisory Board, Königsmann represented OHB at the ILA in Berlin.



Among other things, he talked to the two astronauts Alexander Gerst (left) and Matthias Maurer (right).



# What comes after the ISS?

Headed for the Moon and Mars with Artemis and Gateway

#### How OHB is contributing to the new space station with the Xenon Transfer System

On July 20, 1969, the astronauts of the Apollo 11 mission were the first to successfully land on the Moon: Neil Armstrong and Edwin Aldrin spent a good two-and-a-half hours on the lunar surface before returning to their lander and making their way back to the Earth. Years later, the Apollo 15 mission was launched with an extended stay on the Moon and a greater focus on scientific research. The last of the Apollo missions was Apollo 17 almost 50 years ago. Many space enthusiasts have long felt it is time to take another big step for humankind. This is because the Moon is not only interesting from a scientific point of view but also an excellent place to test new technologies. And OHB is also playing a major role here. NASA and its international partners – including the European Space Agency (ESA) – have made it their next goal to get humans to Mars. The Moon is to be used as a stopover for testing technologies. The technological tests and humans' return to the Moon are part of the NASA-led Artemis program, which is named for Apollo's twin sister, the Greek goddess of hunting, the forest, birth and the Moon. The short-term goal of Artemis is to initiate the return to the Moon. Artemis III is scheduled for 2025 at the earliest, marking the beginning of a new era of research. The medium-term goal is to create a permanent human presence on the Moon with the aim of enabling the next big step for humanity: the one to Mars.

The **GATEWAY** is the next structure to be implemented by the International Space Station partners. The station will be assembled and operated close to the Moon before the end of the decade with the goal of enabling the most distant astronaut space missions ever undertaken. The Gateway is farther from Earth than the current ISS space station and is to be used as a stopover for missions to the Moon and Mars.

#### What is Artemis capable of?

The Artemis program consists of several components. These include the new Space Launch System and the Orion capsule with its European-built service module on the one hand and commercial landing shuttles and new space suits for expeditions on the lunar surface on the other. One aspect that distinguishes the Artemis program from the Apollo program entails the plans to establish a starting point for expeditions into the far reaches of outer space in a lunar orbit from the Gateway space station, which will be engineered by the ISS partners. The establishment of the space station calls for the step-by-step assembly of the infrastructure in space. As with the ISS, the Gateway will consist of various modules that will be connected over time to create a single space station in a lunar orbit. The first two components to be launched into space are the PPE (power and propulsion element) and HALO (habitation and logistics outpost). The PPE provides chemical and solar electric propulsion, while HALO will provide the first small living quarters. PPE and HALO will be launched together (that, at least, is the plan) on board a Falcon Heavy in late 2024 – the first scientific experiments could then commence in the following year.

The International Habitation Module (I-HAB) will follow in 2027 at the earliest with the Artemis IV mission. From then

on, the Gateway should also be available for astronautical missions, meaning that people will be able to live and work there. The I-HAB is one of two ESA contributions. The other one, the European System Providing Refueling, Infrastructure and Telecommunications (ESPRIT), consists of a communications system sitting on top of the U.S. HALO module and the European Refueling Module, or ERM for short. The ERM is intended to provide basic functions: It offers storage space, transports some of the logistics during launch and, thanks to its windows, allows a panoramic view of the lunar surface and other Gateway modules. The module also brings fuel supplies and the necessary technology to refuel the Gateway's drives when needed in what is a highly complex operation. But how does refueling in space work?

#### Fill her up please!

Cars need fuel, and so do satellites and spaceships. Howev-er, the refueling infrastructure on Earth is much better than in space. This means that the lifetime of satellites and the range that spacecraft are capable of covering primarily depend on the amount of fuel they carry on board. The ESPRIT module contributed by ESA will permit sustainable exploration missions from the Gateway.

With aircraft, in-flight refueling has been common practice for decades, at least in a military context; in space, howev-er, such an undertaking is still uncharted territory. Yet, this technology is indispensable for astronautical exploration missions to remote destinations in the solar system. That's why a refueling station in space is required. While the flight to the Moon is still relatively easy to accomplish on a single tank of fuel, interplanetary travel is almost impossible without the possibility of refueling. Why? Because propellant is heavy. Even a mission to Mars, one of the Earth's closest neighboring planets, would call for a volume of propellant that easily exceeds half the launch mass of the entire spacecraft. If you then take into account landing and launch maneuvers as well as the return to Earth, such a mission quickly stops being viable. Being able to plan a journey into space in several stages with refueling stops would therefore be an absolute "gamechanger".

#### Chemical propulsion, electric propulsion

To demonstrate refueling in space and to advance the technology to the level of maturity needed for interplanetary travel, the Gateway will be used as a testing environment. It will have two different propulsion systems for attitude and orbit control: On the one hand, a high-thrust chemical drive and, on the other, a less powerful but more energy-efficient electric drive. Specifically, this is a Hall-effect thruster. As with other ion thrusters, the Hall-effect propulsion system works by ionizing gas particles, which are then accelerated in an electric field to generate thrust and ultimately ejected in the form of a jet. The ion thruster makes it possible to achieve the ambitious research goals of the Artemis program. Only in this way can the Gateway be transferred between Earth/Lunar orbits and stabilized in the target orbit. The destination is the "near-rectilinear halo orbit" (NRHO), a highly eccentric orbit that, on the one hand, brings the Gateway close to the Moon but, on the other hand, also allows it to make wide loops at greater distances. The advantage of this orbit is that, at its point closest to the Moon, the Gateway can be easily approached by lunar shuttles while, at its point furthest from the Moon, transporters from Earth can dock without much trouble. As well as this, the Gateway in an NRHO never completely disappears behind the Moon, something which facilitates radio contact with the Earth.

The Gateway's tank must be refilled regularly to extend its life in a lunar orbit. The space station will have two different refueling systems: one for refueling the chemical propulsion system with hydrazine fuel and another for refueling the electric propulsion system with xenon. The former goes under the name of "Bipropellant Transfer System" (BTS) and is being contributed by Thales Alenia Space in the UK, while the latter is being developed as the "Xenon Transfer System" (XTS) by OHB in Bremen. Both systems will eventually find their place in the ERM of the ESPRIT module.

#### Xenon – the strange gas

Why Xenon? Xenon is a monatomic colorless and odorless gas. Discovered by two English chemists in 1898, it was the rarest of the known noble gases at that time. This fact is directly reflected in its name, which is derived from the Greek word "xénos" meaning "stranger". Xenon is very well suited as a propellant for ion drives. It requires relatively low ionization energy and is non-toxic and also inert, resulting in little to no corrosion of the metallic components of the drive.

Even so, the development of the XTS is anything but straight forward. This is primarily due to the thermal behavior of xenon. The flow velocity, pressure and temperature of the gas are closely linked, meaning that extreme temperature fluctuations may occur during an uncontrolled refueling process. While it is certainly possible to transfer xenon from one tank to another without sophisticated technology, it would take several months to do so, as the gas tends to heat up considerably if transferred too quickly.

#### OHB and the XTS

To prevent this uncontrolled increase in temperature, the heart of the XTS consists of a thermal compressor. This absorbs the gaseous xenon and initially cools it to such an extent that it is partially liquified. Once sufficient liquid xenon has accumulated, it is reheated. This causes it to expand and evaporate, while the pressure simultaneously rises.

With a weight of roughly 40 tons, the GATEWAY will consist of a service module. a communications module, a connectivity module, an airlock for spacewalks, living quarters for the astronauts and an operating station for controlling the robot arm of the Gateway and the rovers on the lunar surface. The station will be placed in a highly elliptical orbit around the Moon. This will facilitate the collection of astronauts and supplies due to its alternating proximity to both the lunar surface and the Earth.

> Artist's representation of the Gateway with the ignited electric thruster.

When a certain pressure is reached, a valve is opened and the compressor discharges. Although this doesn't sound particularly complex in theory, in practice it requires an extremely complicated array of valves with different functions, filters, pressure and temperature sensors, a heat exchanger and much more.

The ESPRIT team is slowly working its way forward, building XTS models of increasing complexity – starting with the breadboard, which consists mainly of non-space-qualified components. Only after a more elaborate model with some components that have already undergone further engineering has been tested will production of the actual flight model begin. The ERM, for which Thales Alenia Space in France is responsible and to which OHB is contributing the unpressurized structure in addition to the XTS, will then be transferred to the Gateway accompanied by a crew of four on NASA's Artemis V mission and docked there. The schedule is as follows: A launch in 2028 is realistic.

#### The big picture

With the development of the XTS, OHB is not only supporting progress in research and science but also working towards the goals defined by NASA for a sustainable lunar campaign and the testing of technologies for the first human flight to Mars. While many components of the Gateway architecture simply entail infrastructure that already exists on board the ISS in this or a similar form, the XTS represents a major step forward – and could ultimately also enhance satellite business as a spinoff. Electric propulsion systems are also popular in commercial near-Earth applications because of their sustainability.

#### **OHB** organization

OHB SE is a European space and technology Group and one of the major independent forces in this industry. With its more than 40 years of experience in the development and implementation of innovative space systems and projects as well as its range of specific aerospace and telematics products, the OHB Group has positioned itself excellently and is well positioned to compete internationally. The Company has locations in key ESA member countries. These locations allow it to participate in numerous European programs and missions.

#### SPACE SYSTEMS

OHB System AG Bremen & Oberpfaffenhofen, Germany 100%

AEROSPACE

MT Aerospace AG Augsburg, Germany 70%

#### DIGITAL

OHB Digital Connect GmbH Bremen, Mainz & Gelsdorf, Germany 100%



\* discontinued operations (IFRS 5)

#### SPACE SYSTEMS

In the SPACE SYSTEMS segment, we design, develop and realize complete space systems. Together with you, we conceive and plan the goal of your mission. This means in particular the development and production of near-Earth and geostationary satellites in the application fields of environmental and weather observation, reconnaissance (civil and military), telecommunications and navigation in pursuit of being "greener, more secure and more connected". In addition, emphasis is placed on the area of space safety. Payloads and instruments are also key areas of expertise in our portfolio to support you in your endeavors. Within the scope of science and exploration missions, we work on studies and concepts for the exploration of our solar system with a focus on Mars, the Moon and asteroids, bringing together the human characteristics of curiosity and ambition.

#### AEROSPACE

With the AEROSPACE segment, we reach the implementation of your mission. We enable access to space by developing and manufacturing small launch vehicles and supplying essential components, tanks and structures for large launch vehicles, mainly for the European Ariane program. We support resource-efficient flying with modern system components for the aeronautics industry, in particular engine components fromour participation Aerotech Peissenberg.

#### DIGITAL

In the DIGITAL segment, we ensure the success of your mission. Our telescopes, ground systems and antennas provide the necessary link between the ground infrastructure and the space segment, which is additionally secured by our expertise in the fields of cybersecurity and encryption. With satellite data analysis, additional applications and professional services, we help you to exploit the full potential of your mission.

### Our LOCATIONS

#### GERMANY

Bremen (1,245) Oberpfaffenhofen (501) Augsburg (616) Mainz (89) Salem (8) Germering (13)

BELGIUM

Antwerp (56)

GREECE Athens (9)

ITALY Milan (169) Rome (34) Benevento (9)

AUSTRIA Graz (13) Vienna (3)

CZECH REPUBLIC Brno (22)

LUXEMBOURG Betzdorf [66]

SWEDEN Stockholm (78)

CHILE Santiago de Chile (42)

> FRENCH GUIANA Kourou (52)

() = Number of employees



# Our EQUITY story

By using satellite imaging, the state of agricultural land can, for example, be monitored more efficiently than on the ground. Thermal infrared imaging can detect heat stress and nutrient deficiencies earlier and more comprehensively.

- A \_ Benefits of space applications
- B \_ Development of the space market
- C \_ OHB's position
- D\_Strategic objectives and implementation
- E \_ Proven profitability
- F\_Growth outlook 2026

#### Benefits of space applications

Space applications are becoming more and more relevant: precise and fast information on developments on the Earth provide the necessary data for making informed decisions and for understanding and forecasting processes. Using satellite data, services are developed to provide specific information on a wide variety of factors, such as weather and climate as well as natural resources. They are also an important component in ensuring security on Earth, for example in the areas of reconnaissance and for disaster and crisis management. The digital transformation is also spurring demand for additional communication capacities in space.



BUDGET DECISIONS BY MINISTERIAL CONFERENCES IN EUR BILLION



#### Development of the space market

A conservative analysis by the industry experts at Euroconsult projects an average annual growth rate of 6.3% for the global space market in the period from 2016 to 2030. Several other organizations go as far as to forecast double-digit annual growth rates.

This is reflected in the fact that the space budgets of the European Space Agency ESA and the European Commission are currently larger than ever: ESA's budget for 2023 (including partner organization shares) stands at EUR 7.1 billion. In November 2022, ESA member countries committed a total of EUR 16.9 billion for the next three years, a 17% increase over the previous three-year period. At 21%, Germany remains the largest contributor. The European Commission's budget for space applications in the current multiannual financial framework stands at EUR 14.8 billion, 17% more than in the previous financial framework.



The OHB Group companies have been broadening their skills and experience over the last few years to meet the expected market changes: In the SPACE SYSTEMS segment, OHB is very well positioned, especially in the field of Earth observation, thanks to various missions that have been carried out and will make a significant contribution to a better understanding of environmental changes such as climate change in current projects such as the EU's Copernicus program. The companies' broad positioning ensures that all solutions can be provided for all space applications.

The AEROSPACE segment is a supplier for various launcher programs. New business opportunities are emerging from the ongoing accumulation of skills and experience in the growth markets that have been identified.

The DIGITAL segment offers a portfolio of forward-looking services and solutions. The skills pooled in this segment are addressing non-space applications more and more. OHB is therefore increasingly making its expertise available to other markets as well. At the same time, the OHB companies are working continuously on developing additional capabilities in the interests of an even better range of applications and services.

**Above:** The companies in the DIGITAL segment have a portfolio of products and services for various industries, including for the digitization of rail systems.

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**Center:** Initial images of the first German hyperspectral satellite EnMAP. The knowledge acquired during the development and integration process has made a major contribution to OHB's position in Earth observation.

**Left:** The Ariane 6 launch vehicle will ensure Europe's independent access to space.

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The Arctic Weather Satellite will improve weather forecasting in the polar regions from 2024. The design of this prototype will subsequently be used for a planned constellation to enable swift and efficient execution. The contract award will follow the prototype launch.

#### Strategic objectives and implementation

In June 2022, the Management Board and Supervisory Board reviewed the assumptions underlying the Group strategy "OHB 2025 - Shaping the future" as well as the targets that had been defined. Subsequently, the Management Board was able to confirm the target that had originally been set in 2020.

The strategic measures will continue to be implemented this year. Implementation successes were achieved across all segments in fiscal 2022: In addition to the successful placement of our small satellite portfolio on the market, this included, for example, the expansion of business relationships in the AEROSPACE segment and the DIGITAL portfolio through the acquisition of the geo-IT specialist GEOSYSTEMS.

#### Proven profitability

Since its IPO in 2001, OHB SE has not executed any cash capital increase. The Group's strong growth in recent decades has been financed from its cash flow. In addition, it has continuously distributed a dividend to its shareholders since 2004 (with the exception of 2020 due to the Covid-19 pandemic). At EUR 0.48 per share, the dividend for 2021 approved last year marks an all-time high.

#### Growth outlook 2026

On the basis of the growth prospects of the European and global space market, the positioning of the OHB companies and their expected business opportunities, the Management Board last year provided guidance for the current year as well as an annual outlook for the Group's three main performance indicators. Following on from the most successful financial year in the Company's history in terms of EBITDA and EBIT, the growth trajectory outlined was continued and confirmed for the most part at the Capital Market Day in 2023.

#### GROUP STRATEGY "OHB 2025 -SHAPING THE FUTURE"







# Review

#### (→01) February 21, 2022 Acquisition of geo-IT specialist GEOSYSTEMS

With the acquisition of GEOSYSTEMS, OHB is adding decades of experience in the procurement, processing and analysis of Earth observation data and a new, diverse and international customer base to its growing DIGITAL portfolio. In addition, the integration of this company will enable synergistic effects and partnership opportunities to be harnessed within the Group.

#### (→02) April 1, 2022 OHB celebrates successful EnMAP launch

The EnMAP environmental satellite was successfully launched from Florida, reaching its target orbit at an altitude of about 650 kilometers. Since then, the first hyperspectral satellite developed and built in Germany has been providing valuable data of an unprecedented quality in the fight against climate change and environmental degradation.

#### $[\rightarrow 03]$ April 6, 2022 Major order from the United States for Ariane 6 launcher

With the award of a contract for 18 Ariane 6 launches for the Project Kuiper telecommunications constellation, US company Amazon is providing strong support for the European Ariane program and its partners. This includes MT Aerospace, with a production share of around 10%.

#### (→04) June 1, 2022 Virtual annual general meeting

At the annual general meeting, which was once again held online, the Management Board and Supervisory Board took questions from the shareholders. In addition, Dr. Hans-Jörg Königsmann was elected as an additional member of the Supervisory Board.













#### $(\rightarrow$ 05) June 17, 2022 MT Aerospace (MTA) contributed

to the development of a hydrogen infrastructure in French Guiana

MTA is participating in the construction of a pilot plant for the production of hydrogen derived from renewable energies to reduce carbon emissions at the European spaceport in Kourou and to encourage the development of a hydrogen ecosystem in the country. In addition, the company is responsible for a hydrogen competence center that is to be established.

#### $[\rightarrow06]$ June 28, 2022 OHB awarded contract for delivery of the instrument for FORUM

OHB System was selected by Airbus UK as the prime contractor for the instrument for the ninth Earth Explorer FORUM of the European Space Agency ESA. The new type of instrument will contribute to a better understanding of greenhouse effects and improve existing climate models.

#### [ ightarrow 07] July 13, 2022 Rocket Factory Augsburg propulsion system successfully tested

The internally developed propulsion system of the RFA ONE small launcher – the first thruster with staged combustion within the EU – was successfully tested several times beyond the critical 8-second mark for the first time. The achievement of this milestone paves the way for test series of the integrated upper and lower stage systems.

#### ( ightarrow 08) July 21, 2022

#### OHB demonstrates its leading global market position for customized telescope systems

OHB Digital Connect handed over a fully mobile high-performance radio telescope to the National Astronomical Research Institute of Thailand, A globally unique mechanism prevents a loss of observation time thanks to lower setup times compared to other telescopes.

#### $(\rightarrow 09)$ September 16, 2022 Next customer gained for microsatellite platform

The selection of OHB Sweden's InnoSat platform for two Earth observation satellites of the Spanish space company Satlantis again underscored its strong competitiveness on the commercial market. This will be its fifth mission.

#### $(\rightarrow 10)$ September 19, 2022 OHB contributes to space surveillance

OHB Italia was awarded a contract for the delivery of a further four "Flyeye" telescopes. They will automatically scan the skies for threats to the space infrastructure and the Earth. The first of the previously commissioned telescopes will be going into operation in Sicily this year.

#### $(\rightarrow$ 11) September 26, 2022 DART probe collided with asteroid Moon on schedule

The impact of DART marked the successful completion of the first part of the AIDA mission. OHB is supplying the second part of the mission with Hera. The probe will reach the impact site in late 2026 and study it at close range. In this way, the effects of the impact and the effectiveness of targeted collisions as a form of asteroid defense can be interpreted and evaluated.

#### $(\rightarrow$ 12) October 25, 2022 LuxSpace proving its credentials with Triton-X platform

With the contract for the SeRANIS mission, the first customer was gained for the Group's third microsatellite platform. The goal of the mission is to establish the first multifunctional experimental laboratory in orbit – the Triton-X platform offers the flexibility needed to integrate on a single platform all payloads for the 15 experiments involving various key and future technologies.

















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#### $(\rightarrow$ 13) November 4, 2022 MATS small satellite launched

The Swedish science satellite MATS successfully launched from New Zealand. As prime contractor, OHB Sweden was responsible for the platform, integration and testing. Since the launch, the company has been operating the satellite from its own control center. MATS studies oscillations in the atmosphere and their effects on the climate.

#### $(\rightarrow$ 14) November 16, 2022 NASA on its way back to the Moon

The new U.S. Space Launch System (SLS) takes off on its first unmanned flight as part of the Artemis-1 mission. Humans are expected to land on the Moon again in 2025. As a partner to prime contractor Boeing, MT Aerospace is supplying tank components for the SLS.

#### $(\rightarrow$ 15) December 3, 2022 OHB Italia awarded contract for IRIDE Earth observation constellation

The constellation will be completed by 2026 and provide Earth observation data for both institutional and commercial customers.

#### $(\rightarrow$ 16) December 13, 2022 Go-ahead given for new-generation European weather satellites

The successful launch of the first Meteosat Third-Generation satellite is paving the way for even more accurate weather forecasting. In addition to the platforms for all six satellites, OHB is also responsible for the instruments fitted to the two sounder satellites.

#### $(\rightarrow 17)$ December 15, 2022 OHB providing the basis for new insights into the origin of our solar system

OHB Italia was selected as prime contractor for the Comet Interceptor mission. The spacecraft will study a yet-to-be-determined target object after its initial entry into our solar system. For this purpose, it can remain in a waiting position at Lagrange point L2 for up to four years after launch.

#### March 15

Annual press conference (annual financial statements 2022) Analyst conference (annual financial statements 2022)

#### May 10

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**Jancia** 

3-month report / analyst conference

May 25 Annual general meeting

August 10 6-month report / analyst conference

November 9

9-month report / analyst conference

#### November 27-29

Deutsches Eigenkapitalforum, Frankfurt am Main

# 2023

GOSATCOM Conference in Munich March 27-29, 2023 gosatcom.et.unibw-muenchen.de/index.php

CYSAT in Paris April 26-27, 2023 www.cysec.com

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14th IAA Symposium on Small Satellites for Earth System Observation in Berlin May 7-12, 2023

www.iaaspace.org/event/14th-iaa-symposium-on-smallsatellites-for-earth-system-observation-2023/

AFCEA trade exhibition in Bonn May 7-12, 2023 www.afcea.de/fachausstellung

International conference on Space Exploration in Turin May 10-12, 2023 www.academieairespace.com/space-exploration/presentation/

The Global Space Conference on climate change in Oslo May 23-25, 2023 www.iafastro.org/events/global-series-conferences/gloc-2023/

BreakBulk Europe in Rotterdam June 6-8, 2023 www.europe.breakbulk.com/Home

Paris Air Show in Le Bourget June 19-25, 2023 www.siae.fr/en/

SmallSat Conference in Logan August 5-10, 2023 www.smallsat.org

Railway Forum in Berlin September 5-6, 2023 www.railwayforum.de

74th International Astronautical Congress in Baku October 2-6, 2023 www.iac2023.org/

Intergeo in Berlin October 10-12, 2023 www.intergeo.de/de/

Europort in Rotterdam November 7-10, 2023 www.europort.nl/

Space Tech Expo Europe in Bremen November 14-16, 2023 www.spacetechexpo-europe.com/

#### Legal notice

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#### About EnMAP (p. 31, 34)

The hyperspectral Earth observation satellite EnMAP was developed and built by OHB System AG on behalf of the German Space Agency at DLR with funds from the Federal Ministry of Economic Affairs and Climate Action. The scientific management lies with the German GeoForschungsZentrum in Potsdam. The DLR in Oberpfaffenhofen built and operates the ground segment.

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