UNITED NATIONS
Office for Outer Space Affairs

Promoting Space Sustainability

Sustainability Case Study

D-Orbit SpA

05.02.2021

Implementation of the Guidelines for the Long-Term Sustainability (LTS) of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space

Operational Case Studies

I. Short description of the outer space activity

D-Orbit is the global market leader in the space logistics and transportation services industry with a track record of space-proven technologies and successful missions. Committed to helping customers profitably and sustainably maximise the opportunities to do business in space, D-Orbit has developed proprietary space logistics technology and transportation *solutions that will accelerate sustainable growth and development* of a trillion-dollar space economy, including human expansion into space. D-Orbit successfully delivers services to customers today while developing advanced products and services for the needs of tomorrow.

Benefit Corporation

D-Orbit was the first space company in the world to become a certified benefit corporation (https://bcorporation.net/directory/d-orbit), and has as part of its corporate purpose the goal to *create a measurable positive impact on society and the environment*. To this end, the purpose and vision of D-Orbit focuses on in-space servicing and transportation to enable profitable business and human expansion *in a sustainable space environment*. We consider *space as a natural resource*, just like air, sea and land, and as such it must be *used responsibly* for the benefit of both people and the environment.

Products and services contributing to sustainable space activities

D-Orbit has been developing its core technologies, products and services with the aim of contributing to sustainable space activities by all actors, with particular emphasis on New Space.

D-Orbit's **D3** decommissioning device, equipped with an independent, smart propulsion system that executes direct and controlled decommissioning manoeuvres, is fully compliant with international space debris regulations. Its use *reduces the growth of space debris*, and can help to *maintain orbits clean* from uncontrolled satellites and *reduce collision risk*. D3 enables operators to extend space missions by allowing the full use of onboard propellant.

D-Orbit's flagship 'InOrbit NOW' Launch Service is an end-to-end launch procurement, hosting, and deployment service that leverages the ION Satellite Carrier, a free-flying spacecraft manufactured and operated by D-Orbit that transports satellites into their desired operational orbit and deploys them into precise orbital slots. It ensures *correctly spaced satellite delivery,* which shortens the duration of launch-and-early-operations (LEOP) and commissioning. This enables earlier start of nominal operations, and ION is also capable of orbital plane changing and orbit raising. D-Orbit always performs *collision analysis* prior to customer satellite deployments, so that they are released in lower risk orbital positions, thus contributing to safer use of the space environment. A collision prediction tool that is integrated in **Aurora** (D-Orbit's distributed mission control software suite) looks at possible conjunctions up to seven days ahead and calculates risk associated with potential events. This *enables operators to assess collision risks and take the necessary operational decisions.*

D-Orbit also leverages the ION platform to host payloads on behalf of customers who need to validate technologies before eventually deploying their own satellites. This provides a cost-effective and lean approach to in-orbit demonstration and validation that also *minimises the number of spacecraft dedicated to payload or service demonstrations*. In addition, this mitigates operational risks associated with the use of experimental technology and provides opportunities for it to mature into *better performing and more reliable technology* for a new generation of space infrastructure.

D-Orbit is working on enhancing the ION Satellite Carrier's capabilities in order to offer in–orbit services such as *extending the life of satellites, moving satellites to new orbits, and end of life disposal of satellites*.

Data from D-Orbit's **D-Sense** can be a key source of *information for space surveillance and tracking activities* and complement existing debris catalogues. D-Sense is a multi-sensor module capable of tracking the position of the Sun, the Earth's horizon and magnetic field, and the angular rate of the spacecraft. Eight D-Sense cameras, one on each vertex of the ION Satellite Carrier, can scan the spherical space around spacecraft for uncatalogued debris and validate the orbital vectors of the tracked objects. D-Orbit aims to *increase the number of tracked and catalogued debris objects*, and to *improve confidence in the existing data*. On-orbit observation techniques can also cover space that cannot easily be tracked from the ground.

Contribution to sustainable development on Earth

D-Orbit's multi-year **NOCTUA** Landscape Monitoring project for the Lombardy Region focuses on the development of a pilot commercial space-based Earth observation service. The end-to-end service will collect, analyze and reprocess data from a specifically designed high-resolution synthetic-aperture radar (SAR) satellite, and distribute critical information to institutions and citizens for:

- monitoring, preservation, and maintenance of infrastructures and natural resources;
- prevention and timely response to natural disasters;

- supporting local economic activities.

Capacity building initiatives

D-Orbit is actively engaged in educational and capacity-building activities.

D-Orbit Academy is a training and professional development programme for current and future D-Orbit team members. Its mission is to provide structured learning opportunities and mentoring to advance capabilities and enable career progression. The Academy supports D-Orbit's growth and is consistent with its Benefit Corporation status. On the societal benefit side, the Academy also looks for opportunities to provide outreach activities in the local community, for example by engaging high and middle schools with company visits and short challenging projects that have the potential to result in real space missions.

D-Orbit has also developed "Distributed Space" – this is a long-cycle, cost neutral, expansion business model to enable effective and low-cost access to space for countries that do not have the resources to develop their own space programme. This model facilitates creation of local expertise and autonomy in the space domain, provides a new market for local businesses, offers advanced training for education, and enables tailored services from satellite data (e.g. advanced agriculture services).

D-Orbit is a member of the Space Safety Coalition and has endorsed its "Best Practices for the Sustainability of Space Operations". The Company participates in and contributes to other organisations and initiatives that promote sustainable space activities. For example, working with ground observation providers to use our ION Satellite Carriers as in-orbit calibration targets for radar and laser observations allows us to provide more accurate information about orbital insertion parameters to our customers, enabling them to take control of their satellites quicker.

II. Connection with the LTS Guidelines

While as a private company D-Orbit is not an immediate addressee of the LTS Guidelines, it strives to adhere to as many of them as possible. Some of the most relevant links between our activities and the LTS Guidelines are outlined below.

Guideline A.2, part 2(c) and part 2(d): *Consider a number of elements when developing, revising or amending, as necessary, national regulatory frameworks for outer space activities.* D-Orbit's technologies, products and services by design address the risks associated with in-orbit operations and the re-entry of space objects. D-Orbit, as a Benefit Corporation, takes very seriously the principle of minimizing the impacts of human activities on Earth as well as on the outer space environment. This principle applies to how we develop, manufacture and deliver our products, and also on how we operate our facilities.

Guideline B.4, part (2): *Perform conjunction assessment during all orbital phases of controlled flight.* D-Orbit has the capability and does perform

collision analysis before releasing customer payloads from our ION Satellite Carrier into their destination orbital slots.

Guideline B.8, part (2): *Design and operation of space objects regardless of their physical and operational characteristics.* D-Orbit's D3 autonomous decommissioning system is fully compliant with applicable international space debris mitigation standards and guidelines. D-Orbit is also an active supporter of introducing the requirement for (European-built or -operated) satellites to be equipped with autonomous decommissioning subsystems. We strongly advocate for this requirement to be included in EU public procurement criteria for the purchase of satellites, to enable use of appropriate award methods through which the EU contracting authorities can contribute to the protection of environment and promotion of the development of sustainable space activities.

Guideline C.3, part (2): *Promote and support capacity-building.* D-Orbit believes that its "Distributed Space" model could very well complement assistance efforts to countries in gathering human and financial resources and achieving efficient technical capabilities, standards, regulatory frameworks and governance methods that support the long-term sustainability of outer space activities and sustainable development on Earth. As part of the "Distributed Space" concept, D-Orbit aims to ensure that the principles in accordance with which it operates are taken up within the new market for local businesses.

Guideline D.1, part (3): *Promote and support research into and the development of ways to support sustainable exploration and use of outer space.* D-Orbit's R&D activities are focussed on enhancing ION Satellite Carrier's capabilities to offer in–orbit services that are aimed precisely at maximizing the use of renewable resources and the reusability or repurposing of space assets.

Guideline D.2, part (3) and part (4): *Investigate and consider new measures to manage the space debris population in the long term.* D-Orbit's mid- to long-term technology and business development strategy has at its core the development of products and services that extend the operational lifetime of satellites (e.g. by refuelling), and enable collision prevention and post-mission disposal using advanced features and capabilities of the ION Satellite Carrier, without posing the risk of environmental pollution caused by hazardous substances.

III. Lessons learned

Quality

Quality is an integral part of D-Orbit's business principles and this requires everybody to be engaged, to understand their responsibility, and to be empowered to take action. Quality is the foundation of our company and is fully embedded in our purposes and values. Teamwork, engagement, ownership, and support by everyone are vital for achieving our objectives. All our actions and initiatives, both internal and external, necessarily consider

the wellbeing of D-Orbit's stakeholders and partners while pursuing a positive return.

The essential elements of our commitment for excellence include: (a) fostering a quality mind-set with the objective of developing, manufacturing and delivering products and services compliant with applicable law, contractual and internal requirements, corresponding to the highest technical and technological standards; (b) encouraging participation and promotion of quality responsibilities amongst all employees and third parties through standards, education, training and coaching, supervision, and effective communication.

D-Orbit believes that it is essential for all space actors to adopt and comply with high quality standards so that space activities are conducted in a sustainable way.

Collaboration

D-Orbit places equal emphasis on three pillars: profit, societal benefit, and global impact. Our products are designed to solve global challenges with a high social impact. Our internal organization leverages the value of people and the positive relationship with all our stakeholders.

D-Orbit looks for mutually beneficial opportunities for cooperation rather than only working in competition. Some challenges are best faced by organisations working together to unite their distinct strengths and leverage their respective resources and skills. D-Orbit participates in several consortia on diverse projects and other initiatives, for example the NOCTUA project.

Coordination

D-Orbit sees a real need to address the tracking of objects in the context of rideshare-launches of multiple small satellites (like the 2017 PSLV launch with 104 satellites or the 2021 SpaceX Transporter-1 launch with 143). These events pose two issues, which D-Orbit had direct experience of during its January 2021 ION mission: following their release, individual satellites are hard to track, which hampers LEOP and commissioning activities, creating further unnecessary risks in-orbit. D-Orbit is now looking at using VHF/UHF beacons on future missions to support LEOPs. Also, D-Orbit, with consent, needed to use ground stations other than previously declared to ITU – this raised the need for coordination with additional international stakeholders and flexibility from such entities.

Final Words: Building Our Future

D-Orbit's CEO, Luca Rossettini, has spoken regularly about the sustainability of space activities. In 2020, he said: "The last 200 years have been an era where we achieved an exponential technological development at the expense of our planet. We can't afford to go on like this in the future and moving backwards is not an option. We have a chance to shape the future of humanity by developing sustainable production processes, businesses, and lifestyles, and each one of us can give a contribution in that sense."