**IAF Committee Briefs** 



Winter 2022

# IAF SPACE TRANSPORTATION COMMITTEE

## 1. Introduction

The objective of the IAF Space Transportation Committee is to address worldwide space transportation solutions and innovations. In particular, the goals are:

- To foster understanding and cooperation amongst space business academicians and practitioners, through the creation, diffusion, and adoption of new knowledge and lessons learned
- To build a world-wide network of communication and relationships
- To encourage, promote, and assist the development of newer members of the space community through IAC participation

The corresponding activities are devoted to different types of space transportation missions, systems (launch vehicle system and/or the propulsion stages, expendable or reusable, manned or unmanned) and to their safety and support operations.

The committee organizes the D2 space transportation symposium during the yearly International Astronautical Congress including following technical sessions: Launch Vehicles in Service or in Development, Launch Services, Missions, Operations, and Facilities + Upper Stages, Space Transfer, Entry & Landing Systems + Future Space Transportation Systems + Small Launchers + Space Transportation Solutions for Deep Space Missions and on Emerging Space Ventures, including Space Logistics and Space Safety for Sustainability.

## 2. Summary

One of the major highlights in 2022 is once again linked to the achievements in commercial human space transportation with the continuation of successful flights of Blue Origin and SpaceX.

On 31 March 2022, Blue Origin's New Shepard vehicle

performed its fourth crewed suborbital spaceflight with six passengers on board. On 4 June 2022, New Shepard performed its fifth crewed suborbital spaceflight, also with six passengers on board. On 4 August 2022, New Shepard performed its sixth crewed suborbital spaceflight, again with six passengers on board.

On 8 April 2022, SpaceX's Crew Dragon space capsule was launched by a Falcon 9 rocket for the first American space tourist mission to the International Space Station. The crew on board the Axiom Space-operated mission included one professional astronaut (space vehicle commander) and three tourists. The mission, known as Axiom Mission 1, lasted a little over 17 days and was the first wholly commercially operated crewed mission to the ISS.

Further there is a good deal of growth currently in small startups and new launch vehicle developers in the United States in particular, but in the world as well. Some companies are focusing on more agile launchers that can be launched from novel locations, some are focusing on smaller launchers for smaller satellites, some are focusing on new technologies such as additive manufacturing, and others are attempting to use novel materials or new technologies to break into the market.

Additionally, the major players are working to extend booster reusability (multiple companies working on this right now) as well as significant improvements in up mass capability. In general the launch vehicle space is in a period of very high innovation.

Regarding the Brazilian space sector and related advances in space transportation technology and launch operations, it can be understood that Brazil is in a moment of transition. The Brazilian space program, although traditional in its inception, is now adapting to include a larger participation of the private sector in technology development and to begin our commercial launch activities from the Alcântara Space Center (CEA).

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This perspective brings new challenges, such as the technology transfer from the public institutes to the industry and the creation of a new legal framework that can usher the beginning of orbital launches from Brazil.

AEB published the Regulations for Licensing of Space Activities Operator and for Launch Authorization in Brazilian territory. This initiative is important because the regulations are similar to those already adopted by the FAA. The idea is to make it easier and faster to issue licenses for companies that already have an FAA license or have already started the process in the United States.

# 3. Highlights

## <u>ITALY</u>

Italy is pursuing the follow up activities to setup and outfit the airport of Grottaglie designated by the Italian Government as future spaceport for suborbital flights and national strategic infrastructure; interactions are on-going to attract operators of new technology for access to space.

Italy has heavy involvement in the ESA Space Rider project, an automated space vehicle, which can be reused for unmanned re-entry. Leveraging on the heritage of the IXV mission and on the experience gathered in the frame of ISS and data processing activities, ALTEC supports the missions of Space Rider encompassing the roles of Payload and Landing Control Center. ALTEC is the gateway for all Payloads onboard Space Rider, guaranteeing a safe return and landing of the spacecraft and its cargo.

#### BRAZIL

For the past years, Brazilian Space Program (PED) has advanced on filling the technological gaps that are present on our path to national access to space. The recent testing of the largest Solid Rocket Motor (SRM) up to date, the S-50, has sparked needed interest in the full development of the Micro Launch Vehicle VLM and other parallel roadmaps. The S-50 is a successful case for technology transfer from the institutes to the industry, as it is developed in tandem between the Institute of Aeronautics and Space (IAE) and partners from the industry. Another recent success case was the launch of the first privately built VSB-30 rocket, our most successful sounding rocket, transferred to the industry and previously offered by the government (IAE).

Although traditionally the PEB has focused on SRM for rocket development, the national private sector

has shown great interest in Liquid and Hybrid Rocket Engines. A study on the topic was published by committee member Danilo Sakay on the D2.4 session of the 73<sup>rd</sup> IAC (IAC-22,D2,4,4,x70089). The government has recently opened a public call for Nano Launch Vehicles, as a first step to stimulate the industry with the challenge of orbit insertion with a new launch vehicle prototype.

Brazil is working to transform the Alcântara Space Center into a commercial center for space activities. The AEB made two public calls for companies interested in operating in the center. Two companies have already signed contracts to use the center.

#### UNITED STATES OF AMERICA

Rocketlab's small reusable launcher Electron was captured via a "catch" in May of 2022. Many other vehicles are in development of landing technologies to continue to improve the reusability of launch vehicles. SpaceX has demonstrated 14 flights on a single Falcon 9 booster.

On the large launcher front, SpaceX is testing the largest launch vehicle ever built with the intent of becoming the first vehicle with a reusable first and second stage, contracted with NASA to send payload and passengers to the moon. NASA's SLS launcher is nearing readiness for its first flight, and Blue Origin is also working on their first launch of New Glenn which will bring another heavy launch vehicle to the market as well.

SpaceX, Blue Origin, and Virgin Orbit continue to fly private astronauts to low earth orbit and the edge of space, commercializing space travel in a way that is unprecedented and has potential to change the market for human spaceflight substantially.

SpaceX has also flown its Falcon 9 rocket 48 times this year to date, holding the record number of launches for any launch vehicle in a given year and is on track to hit an average of one launch per week this year. This highlights the commercialization of space and indicates that more commercial mass is getting to orbit than ever before.

NASA has scheduled a new attempt to launch the Space Launch System for the Artemis I mission for November 14, after two previous attempts were aborted, first due to anomalies during the propellant filling procedures, then due to weather risks.

In October 2022 Firefly Aerospace successfully launched its first launch vehicle, which reached orbit.

#### <u>EUROPE</u>

The first test on upper-stage Vinci engine in the P5.2 test bench in DLR Lampoldshausen has been performed in October 2022. In parallel, the development of the ASTRIS kick stage of Ariane 6 (based on the BERTA engine) is continuing.

The Vega-C launcher, based on the P120-C solid rocket motor for its first stage and on the Zefiro 40 solid rocket motor for the second stage, performed a successful maiden flight in July 2022, bringing seven satellites to orbit.

In-space mobility provider Benchmark Space Systems has been selected by The Exploration Company, a European start-up developing in-orbit exploration vehicles, to develop the propulsion system for its second demonstrator flight ('Mission Possible') which is set to launch in 2024. Benchmark and The Exploration Company will work together to develop an innovative propulsion system that will utilize non-toxic high-test peroxide propellant. The system will be based on Benchmark's flight-proven Halcyon Avant propulsion system, featuring Benchmark's 22N "Ocelot" bi-propellant (HTP + IPA) thrusters. The Exploration Company has scheduled the launch of its demonstration Mission Possible for 2024, with the main objective being to perform a safe re-entry of the capsule that will host payloads from first customers. Moreover, the target is to perform a safe splashdown in the ocean, including recovery. As a final objective, The Exploration Company looks forward to the demonstration of its propulsion capabilities during orbital flight, as well as during re-entry, using the aforementioned propulsion system in preparation of the planned maiden flight of The Exploration Company's orbital vehicle Nyx Earth, that will take place in 2026.

#### <u>ASIA</u>

South Korea has successfully launched its Nuri rocket in June 2022. The launcher is powered by LOX – Kerosene engines.

The ZK-1 solid propellant rocket made its maiden flight on July 27. This rocket was developed by the Chinese Academy of Sciences (CAS). It has the 2.65 meter in diameter and 30 meter in length. The ZK-1 is capable of sending payloads of 1,500 kilograms into 500-kilometer Sun-synchronous orbits (SSO).

# 4. Future Outlook

SLS is at the launch pad now and will bring a high mass

capability launcher back to NASA for lunar exploration missions and high payload science missions.

Next year should see first flights of Starship and New Glenn, ushering in cutting edge vehicles that have up to 100t lift capability with reusability in mind.

On the small launcher front, competition is expected to drive cost down and access to space up for small payloads as these companies compete for launch contracts and bring in new previously undeveloped markets for launchers.

The global demand for private astronauts as well as the increased number of providers is expected to bring a larger and larger number of people to travel to and work in space. With the lofty goals of NASA's Artemis mission and the combined vehicles of SLS and Starship, return to the Moon and exploration of Mars are more real than they have been since the 1960s. With the capability that these vehicles bring and the improvement in operational cadence being demonstrated, large amounts of payload could be delivered to these locations, enabling more permanent human presence, such as a lunar and mars base.

In near future, Brazil can offer access to space, either through the commercial services of international companies operating at CEA or by our own means, with the VLM or new small launch vehicles for dedicated missions.

The parallel activities of commercial launches and launch vehicle development will hopefully engage the Brazilian ecosystem towards a stable stage of production and evolution, where the national industrial park is kept active by a multiple projects and growing demand for launches.

Brazil is working in a few studies for 2023:

- Space regulations as instruments of competitiveness of launch countries
- Public financing instruments for space investment in Brazil
- The financing model for research and development activities in the Brazilian space sector

The following important maiden flights are planned:

- H3 –JAXA Japan
- Space Launch System NASA USA
- Starship SpaceX USA
- Spectrum (de) Isar Aerospace Germany
- RFA One RFA Germany
- Prime Orbex Scotland

- C6 Launch Systems Canada
- Terran 1 Relativity Space USA

# 5. Committee activities

The Space Transportation Committee will continue the organization of virtual meetings / webinars in between the IACs and the spring meetings. The 3<sup>rd</sup> webinar is scheduled for December 2022. Also, after the successful special session in frame of the IAC 2022, it is discussed

within the committee, if another special session, plenary or GNF should be proposed by the committee w.r.t. IAC 2023 in Baku. Especially as new space transportation systems will be launched soon for the first time like SLS and Starship. Then it is in discussion within the committee, if and how social media could be used in order to promote the committee activities. Finally fostering synergies with other relevant space conferences are checked.

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