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Innovation in Space Launch Vehicle Utilisation

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India is a growing space power and enjoys a reputation as the sixth most competitive space power in global rankings.[1] However, its reputation in space has been affected by a declining launch rate ever since the Covid-19 pandemic took its toll on the country. While the launches by the Indian Space Research Organisation (ISRO) peaked at seven launches in 2018, the space agency could manage only two launches each in 2020 and 2021.[2] ISRO's launch mission on June 30, 2022, thus comes as a welcome event, being the second launch of 2022. ISRO has planned at least 6 more missions for the current year, which include an Earth Observation Satellite (EOS) mission, the first Reusable Launch Vehicle Runway Landing Experiment (RLV-LEX) technology demonstrator mission, a Small Satellite Launch Vehicle (SSLV) launch, Chandrayaan-3, Aditya-L1 and a Gaganyaan mission.[3]

The recent Polar Satellite Launch Vehicle (PSLV) launch of June 30, being termed PSLV-C53/DS-EO, may appear to be a routine launch by the space agency, but is unique in many ways. The mission demonstrates the use of the spent upper stage of the PSLV as a stabilised platform for carrying other experimental payloads for scientific experiments after the separation of the main satellites. This is a unique innovation by ISRO. The C-53 mission is also the second dedicated commercial mission of New Space India Limited (NSIL). It put into orbit three satellites from Singapore. The mission was also the 55th launch of ISRO's workhorse rocket-PSLV.[4]

In this experiment, the spent rocket stage (fourth stage), which would have otherwise orbited in space as a piece of debris, is being used to conduct experiments by mounting scientific payloads on the upper stage of the rocket. It is also called the PSLV Orbital Experimental Module (POEM). The module has been equipped with certain features to enable stabilised orbital characteristics and prevent tumbling in space, which is crucial for the success of the experimental payloads. It is heartening to learn that POEM carried six payloads, including two from Indian Space Start-ups - Digantara and Dhruva Space - which ensured maximum utilisation of the launch. Here, it is pertinent to note that the upper rocket stages are normally left in space after releasing a satellite at its intended altitude. These spent rocket stages would then remain in orbit for many years, or even decades, depending on the orbital altitude. Hence, utilisation of the upper rocket stages for hosting satellite payloads is not only cost-effective but also contributes to debris management. Though this technique is not unique to India, it is certainly a viable option till expertise is developed in achieving controlled re-entry of the upper stage rocket or, better still, using the whole rocket as a reusable launch vehicle[5]

Another unique aspect of the space mission was the opportunity given to the two space start-ups – 'Digantara' and 'Dhruva Space' – to fly their payloads onboard the PSLV rocket. Dhruva Space

deployed its satellite orbital deployer: DSOD 1U, a satellite deployment system whose compatibility was tested with the PSLV rocket. The mission demonstrated their in-house developed CubeSat Deployers ahead of the launch of Dhruva's future satellite missions, which also cater to international clients. The company plans to offer satellites coupled with ground stations and launch services as an integrated solution for customer requirements.[6] Digantara on the other hand is developing space-based solutions for Space Situational Awareness (SSA) and debris avoidance and intends to catalogue all space objects. The payload hosted on PSLV C-53, however, is different. They call it the 'ROBust Integrating' (ROBI) proton fluence meter, which is a space weather data collection device. Testing of this device is a vital step towards realising Digantara's space weather measurement and analysis capabilities, which will be used in the company's future space situational awareness platform. Space weather is also a component of SSA. Digantara's ROBI is the world's first commercial space-based weather data system and also the smallest.[7]

It is a win-win situation for such start-up companies, which not only got an economical launch option to test their equipment but also got a launch facility with no extra liability than that of PSLV. This is a giant leap for both these companies, having launched their first payloads into space. Such developments are very promising for India's space technology advancement and would definitely encourage more innovators to aim bigger and achieve higher.

NOTES

[1] "The 10 countries most active in space", *Aerospace Technology*, December 21, 2015, https://www.aerospace-technology.com/features/featurethe-10-countries-most-active-in-space-4744018/. Accessed on July 05, 2022.

[2] 'All Missions', launch data available at ISRO website at https://www.isro.gov.in/all-missions-0. Accessed on July 05, 2022.

[3] Suchitra Karthikeyan, "ISRO's upcoming space missions in 2022: From Chandrayaan-3 to Aditya L-1" , *The Hindu*, May 24, 2022, https://www.thehindu.com/news/national/isros-upcoming-space-missions-in-2022-from-chandrayaan-3-to-aditya-l-1/article65420154.ece. Accessed on July 05, 2022.

[4] "PSLV-C53/DS-EO Mission", *ISRO*, June 30,2022, https://www.isro.gov.in/launcher/pslv-c53-ds-eo-mission. Accessed on July 06,2022.

[5] Ibid.

[6] Harsh Vardhan, "Indian Space Startups Dhruva Space, Digantara To Test Their Technologies In ISRO Mission", *Republic World*, June 26,2022, https://www.republicworld.com/science/space/indian-space-startups-dhruva-space-digantara-to-test-their-technologies-in-isro-mission-articleshow.html. Accessed on July 07, 2022.

[7] Jason Rainbow, "Communications established with payload on stabilized PSLV upper stage", *Space News*, July 06,2022, https://spacenews.com/communications-established-with-payload-on-stabilized-pslv-upper-stage/. Accessed on July 7, 2022.