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A FURTHER FILLIP TO INDIAN SPACE CAPABILITY

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Introduction

India's capabilities in space activities have come a long way from the days of launching sounding rockets imported for the most part from foreign countries such as the US, France and the USSR. Initial Indian advances were made in design and development of satellites of ever increasing complexity in the mid to late 1970s. A stage was reached in the late twentieth century where the Indian Space Research Organisation (ISRO) had achieved self sufficiency in design and manufacture of satellites for such diverse purposes as remote sensing, communications, etc. the next step was the ability to put these satellites into orbit around the earth. After a few failures associated with the learning process ISRO succeeded in successfully launching the Satellite Launch Vehicle (SLV).

Progress in Indian Space Launch Capabilities

From the starting point of achieving success with the SLV rocket, which was able to put a mere few tens of kilograms into earth orbit, ISRO progressively developed the augmented SLV (ASLV) and Polar SLV (PSLV). Since then ISRO has been endeavouring to build up the capability to launch heavier satellites than is possible with the PSLV. The PSLV has the best track record of all Indian satellite launch rockets. It has an operational record of a string of over 28 successful launches in succession[1]. The PSLV also has the distinction of having launched as many as ten satellites in a single mission, thus displaying its precision and flexibility. It is widely acknowledged that the PSLV has an enviable record of inserting its payloads very accurately into their desired orbits[2]. Such accuracy result in conservation of the satellite concerned's onboard fuel and thus extends its useful life. PSLV was also the rocket used in a specific configuration that employed additional strap on boosters to launch the Mars Orbiter Mission (MOM) and the Chandrayaan-1 spacecraft. These successes with the PSLV mark the launch vehicle as a robust and dependable launch rocket that is competing for commercial launch of foreign satellites. Till date 45 satellites belonging to 19 countries have been launched by PSLV rockets[3]. Antrix Corporation, the commercial arm of ISRO, is reported to have signed a commercial contract to launch nine US nano satellites in period 2015-2016. This is the first time that ISRO will be launching US satellites[4]. The next step for ISRO has been to develop the ability to launch heavier payloads than can be achieved with the PSLV. PSLV can launch up to 1,750 kg to a 600 km Sun Synchronous Polar Orbit (SSPO) and 1,425 kg to a Geosynchronous or Geostationary transfer orbit (GTO). Many of the more complex satellites built by ISRO weigh more than 2,000 kg, going up to approximately 4,000 kg. launch of these satellites has been perforce been carried out by foreign launch rockets such as the European Space Agency's Ariane rockets in view of the inability of ISRO to launch heavier payloads. ISRO has been working on the technology for launching heavier payloads through development of its Geosynchronous Satellite Launch Vehicle (GSLV). A crucial technology for fructification of the definitive GSLV is that of cryogenic engine technology for the upper stage of the GSLV rocket. Initially, in the late 1980s ISRO attempted to obtain this cryogenic technology on a technology transfer basis from the Soviet Union. Dismantlement of the Soviet Union and subsequent pressure on Russia by the US led to the technology transfer not fructifying. Since then ISRO has been trying to develop cryogenic engines on its own. Cryogenic engine technology is very high end technology and it involves utilisation of fuels stored at extremely low temperatures and the controlled mixing and ignition of these very cold fuels. Cryogenic engine technology has been operationalised by very few countries. This endeavour to develop an indigenous cryogenic engine has proved to be a troubled path for ISRO with success eluding the organisation for many years. The initial flights of the GSLV rocket were achieved with use of imported Russian cryogenic engines. In parallel efforts to develop the indigenous cryogenic engine continued. After a series of ground tests, the first successful flight of a GSLV rocket using an Indian cryogenic engine was achieved in January 2014. This rocket is able to put payloads weighing up to 5,000 kg to low earth orbit (LEO) and 2,500 kg to GTO. The second successful flight of the GSLV with an indigenous cryogenic upper stage (CUS) was conducted on 28 Aug 2015 when the rocket placed the 2,117 kg heavy Geosynchronous Satellite (GSAT)-6 in GTO.

Analysis of the GSLV Success

With this success of the launch of GSLV Development flight (D)-6 ISRO appears on track to prove the CUS and to establish the required data stream to move the GSLV rocket from a developmental vehicle to a commercial vehicle. For this to take place a few more development launches are likely to be carried out in order to practically prove the GSLV rocket's reliability. Once this is done the GSLV could be expected to be offered to carry out commercial launches in a higher weight class than is possible with the PSLV. Further development of the basic GSLV rocket are likely to include a Mark-II and a Mark-III version with heavier payload capability than the basic GSLV rocket. The success of the GSLV is important for ISRO in that this rocket family will enable the organisation to place heavier payloads into earth orbit and to launch space probes with greater efficiency. The Indian manned space program also will require a reliable heavy lift capable rocket system. Thus it is clear than considerable importance attaches to the development of the GSLV family into a reliable family of rockets. Future space exploration and exploitation efforts are linked to the heavy payload lift ability that the GSLV is likely to deliver to ISRO.

ISRO is reported to be working towards its first technology development and demonstration flight of the components of a reusable launch system towards the latter half of calendar year 2015 [5]. This technology development and demonstration is expected to lead to the later development of a two stage to orbit (TSTO) launch system with reusable parts. Such a system once it reaches operational maturity could drastically reduce the cost of placing payloads into space and make ISRO even more competitive in terms of reliability and price than it is today[6].

ISRO has already placed four of the planned seven satellites of the Indian Regional Navigation Satellite System (IRNSS) into orbit and is working on the final three satellites[7]. ISRO also operates the world's largest civilian remote sensing satellite constellation comprising primarily its Indian Remote Sensing (IRS) satellites[8].In addition ISRO already has the MOM and Chandrayaan-1 missions behind it. These achievements indicate that while it remains behind the world leaders in space technology, namely Russia, China and the US, ISRO has the potential to operate at the cutting edge of space technology through primarily indigenous effort. With each passing day ISRO seems to be closing the gap with the leaders in space exploration and research. This bodes well for the economy as well as the security of the country.

Conclusion

ISRO has made great progress since it initiated its initial forays into space exploration in the late 1960s. After achieving self-sufficiency in satellite design and fabrication ISRO has been working on the next building block of space technology, launch vehicles. From the first SLV, ISRO has progressed substantially to make the PSLV a proven work-horse with an enviable track record and is now making progress towards proving the GSLV to make it available for commercial utilisation. Coupled with the space applications ISRO already offers in terms of its IRS constellation and IRNSS finalisation the GSLV is likely to enable more complex missions in future and its success bodes for India's space program.

Notes

[1] http://www.isro.gov.in/launchers/pslv

[2] Ibid.

[3] PTI, "ISRO to launch 9 nano/micro American satellites during 2015-16", *The Economic Times, August 4, 2015*,http://economictimes.indiatimes.com/articleshow/48347993.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst, accessed on 30 Aug 2015.

[4] Ibid.

[5] http://www.spaceflightinsider.com/organizations/isro/indian-space-research-organisation-to-test-its-reusable-rlv-spacecraft/, accessed on August 30, 2015.

[6] Ibid.

[7] http://www.isro.gov.in/irnss-programme

[8] http://www.strategic-affairs.com/details.php?task=other_story&&id=434, accessed on August 30, 2015.