

Moon Shot is just the beginning, India harnesses space technology for the benefit of all.

India's Moon Shot is well on its way to the Moon and if all goes well the Indian Space Research Organisation (ISRO) hopes to soft land a robotic craft on the lunar surface in early September. Dr K Sivan the Chairman of ISRO has described the Chandrayaan-2 (Moon Vehicle) as the 'most complex space mission ever undertaken by India'.

India has a total of fifty operational satellites that provide navigation services, weather forecasting, help smart cities, aid satellite television and even help in banking operations, today 'touching lives and saving lives is the Hallmark of ISRO' says Sivan. India has end-to-end capabilities in space making its own satellites, rockets and launching them from India. Many foreign companies use India's rockets to launch their satellites. The South Asia satellite launched in 2017 is a unique friendly bird in the sky that helps connect India's neighbours and India provided this communications satellite at no cost to the South Asian countries.

Most recently on the hot and humid afternoon of July 22, 2019 at India's rocket port the Satish Dhawan Space Centre at Sriharikota exactly at 2.43 pm India's most powerful rocket the Geosynchronous Satellite Launch Vehicle Mark-3 nicknamed the 'Baahubali' lifted off into the monsoon clouds carrying India's Chandrayaan-2 satellite into space. In less than 17 minutes the 640 tonne rocket, equivalent to the weight of 1.5 Jumbo Jets, which stands as high as fifteen storey building at 44 meter in length completed its mission by putting the Chandrayaan-2 satellite in a 'better than expected orbit' said Sivan.

Possibly the rocket was compensating for the heartburn it caused when a week earlier on July 15, 2019 the launch had to be aborted less than an hour before lift-off due to a 'technical snag'. Scientists at the Indian space agency burnt the mid night oil and fixed the glitch, bouncing back with aplomb. Speaking about the rapid come back Indian Prime Minister Narendra Modi said 'if you ask me what the two greatest lessons I have received from Chandrayaan-2, I shall say they are faith & fearlessness.'

Modi is a known space enthusiast who knows how to deploy space technology for effective governance of the 1.3 billion Indians, he further added 'the second important lesson is – never lose hope in the face of stumbling blocks or obstacles. The way our scientists rectified technical issues in record time, burning the midnight oil, is in itself an exemplary, unparalleled task. The world watched the 'Tapasya', the awesome perseverance of our scientists. We should also feel proud of the fact that despite hindrances, there is no change in the arrival time [on the moon] ... many are

amazed at that. We have to face temporary setbacks in life... but always remember- the capacity to overcome them resides within us.'

Earlier this year India also carried out another spectacular space experiment when on March 27, 2019 India shot down its own low earth orbiting satellite Microsat-R using a custom made missile launched from the Kalam Island in the Bay of Bengal. Called an Anti-satellite weapon test (A-Sat) it was dubbed 'Mission Shakti' and according to Dr G. Satheesh Reddy, Director General of the Defence Research and Development Organisation (DRDO) which spearheaded this test said 'India acted responsibly by conducting the test at a low altitude so that minimum space debris was generated'.

Prime Minister Narendra Modi said 'through the A-Sat, we have acquired the capability of destroying a satellite three hundred kilometres away in a mere three minutes. India became the fourth country in the world, possessing this capacity' after USA, Russia and China who have demonstrated this lethal capability to knock down satellites in space. This was a demonstration by India that it will do all what it takes to protect its vital space assets in space. Indian satellites help the country's economy and are a vital space borne infrastructure for New Delhi.

Chandrayaan-2 is India's second moon shot the first was launched in 2008 named Chandrayaan-1 and it was an orbiter where 'India was the captain and several countries like USA, UK, the European Space Agency were players as India lofted their instruments all the way to moon free of cost'. Chandrayaan-1 made global history when this under \$ 100 million mission made the startling discovery of the presence of water molecules on the parched lunar surface. This renewed twenty first century 'back to the moon' effort in way was spurred by Chandrayaan-1 and now USA seeks to send astronauts back to the moon in the next few years.

Chandrayaan-2 according to Sivan 'is a three in one mission' where there is an orbiter that will go around the moon, a lander named Vikram that will attempt a soft landing near the South Pole of the moon and small six wheeled moon rover called Pragyaan. Modi says 'Chandrayaan-2 is Indian to the core. It is thoroughly Indian in heart & spirit. It is completely a 'swadeshi', home grown mission. This mission has proved beyond doubt, once again, that when it comes to attempting an endeavour in new age, cutting edge areas, with innovative zeal, our scientists are second to none. They are the best... they are world class.'

India has sent 13 indigenously made scientific instruments that will analyse the lunar surface, map the topography search for water and measure moonquakes among other things, this time also India is carrying a small instrument for the American space agency NASA on board the Vikram Lander.

The Indian moon rover is powered by artificial intelligence and is expected do its long march on the moon surface for about half a kilometre in its nominal life of 14 days. ISRO hopes to soft land on the lunar surface on September 7, 2019, and if it

succeeds India will become the fourth country after USA, Russia and China to have the capability to soft land on another planetary body. Sivan says 'there will be 15 terrifying minutes when the Vikram lander goes in for its final landing manoeuvre'.

This is not all, by the end of this year India has another ten space missions lined up which includes the much awaited heart stopper the demonstration of the Small Satellite Launch Vehicle (SSLV) or the 'Baby PSLV' a low cost rocket with a short turn-around time that can hoist 500 kilograms in space.

India also has plans to send a planetary explorer to Venus, have another robotic mission to Mars in the next few years. The mother of all missions Gaganyaan is also well on its way where, by 2022 India hopes to send an Indian astronaut into space on an Indian rocket from Indian soil.

India is no doubt betting big on space technology. Modi says 'I fervently hope that the Chandrayaan-2 mission will inspire our youth towards science & innovation. After all, science is the path to progress.'

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