# India's Rise as a Global Space Power in 2020

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## Introduction

The dreams of space scientists such as Sergei Korolev, Von Braun and Vikram Sarabhai pale in comparison to the strides made in space during the past 50 years. Since 1957, mankind has witnessed numerous space milestones such as the placing of more than 1,000 satellites in orbit, emergence of a dozen space-faring nations, space probes to distant planets in the solar system, establishment of the International Space Station at altitudes varying from 330 to 410 km and space exploration to establish habitats/colonies in outer space. The progress in the field of space has been so profound and competitive that the US, in its endeavour not to be left behind, outsourced its 30-year-old Space Shuttle Programme in 2011 to private industry and redirected its resources towards far distant space objectives such as robotic missions to Mars and Jupiter. We are now entering the golden age of space exploration, wherein many ongoing and forthcoming missions from the National Aeronautics and Space Administration (NASA) may change the way we view the universe and life in the universe.[1]

India, with its successful launch of the Chandrayaan-1 in October 2008 and other missions in the pipeline such as the Chandrayaan-2, Astrosat and Aditya, has a well established space and ground segment and is recognised as one of the few frontline space powers. The Indian Space Research Organisation (ISRO) has its own indigenous programme and well planned space objectives which will help India in emerging as a world space power by 2020. On Septmber 9, 2012, ISRO reached another important milestone when it carried out its 100$^{th}$ launch by placing French and Japanese satellites in orbit.

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**N.B.** The views expressed in this article are those of the author in his personal capacity and do not carry any official endorsement.

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## National Power and the Space Component

Since the origin of mankind, the three media of land, water and air have been continuously dominated by nations the world over to showcase their supremacy in these media.[2] With the advent of technology, the medium of space started getting explored, the first space milestone being the launch of the Sputnik by the Russians in 1957. Since then, space has become a vital component of any nation's might which has surpassed conventional borders and frontiers. The 1991 Gulf War gave a new dimension to military applications of space as space assets largely governed the outcome of operations on land, sea and air.[3] In the present context, it is relevant to say that space has been transformed from an object of wonder to an arena of practical, economic and strategic significance.

Today, a country cannot think of emerging as an economic power if its growth strategy does not include commercial applications of satellites. Use and denial of these applications is one of the key factors towards gaining a tall status in the global power bloc.[4] Space power is the ability of a nation to exploit the space environment in pursuit of national goals and purposes and includes the entire astronautical capabilities of the nation. These non-military capabilities could include the ability to predict weather, build communication satellites for the rest of the world or earth resource data collection.[5] Space-based applications are a strong tool to exhibit a nation's global dominance. The only way to have absolute power in space is by exerting control and influence over other nations active in that medium.[6]

## Colonising Space in 2050

In 1980, Charles Panati stated that a space colony landscaped with parks, lakes and mountains to house thousands of people could be orbiting the Earth by 2000. In the early 1980s, some scientists also believed that by 2150, more people would be living in orbiting space colonies than on Earth.[7] Although the progress towards colonisation of space has not unfolded exactly as per the predictions of Charles Panati, enough progress has been made in other areas. Today, space technology is well advanced and suitably poised for realisation of extraordinary ventures into space, including establishment of habitats in outer space. As we move into the second half century of the space age, control of key geographical regions in space and their subsequent colonisation would remain the thrust area for leading space-

faring nations.[8] Few nations, due to their technological capabilities, will be able to exert a 'technological control' over regions in outer space.[9] Such deep space endeavours will have to be based on cooperation between various space-faring nations.[10] These space colonies/stations with their zero gravity conditions could then be used to manufacture a new generation of high technology materials such as exotic alloys, foam metals, ultra-pure semi-conducting crystals and rare vaccines.

## *American Space Programme*

The US which lagged behind the erstwhile USSR in the 1960s, is now the undisputed space superpower as on date. Having established itself as a leader in all areas of space applications such as communication, surveillance, navigation and others, it is now well poised to probe deeper into outer space. With the landing of the $2.6 billion "Curiosity", undoubtedly, the hardest and most ambitious robotic exploration mission ever attempted, NASA has once again proved its supremacy in space.[11] The rover will spend years on the Red Planet and gather scientific data which will help NASA to analyse the suitability of Mars for human life.

Since 2008, the US has already started working on "Project Constellation" a series of missions with the final aim to land man on the Moon in an Orion craft. By the end of this year or the start of 2013, the Lunar Atmosphere and Dust Environment Explorer (LADEE) will determine the global density, composition and time variability of the fragile lunar atmosphere, determine the size, charge and spatial distribution of electrostatically transported dust grains and assess their likely effects on lunar-based astronomy. The 'Mars Astrobiology Field Lab Rover' will look for signatures of life on Mars: it will be conducting biological tests rather than geological tests. This mission will be initiated in 2016. The James Webb Space Telescope is scheduled for launch in 2018 to look for the first luminous objects after the Big Bang and unravel how galaxies evolved.[12]

## *Chinese Space Odyssey*

China's space programme has been admirable since its inception in the 1960s. The origin of China's space programme can be traced back to the late 1950s, when it started with the ballistic missile programme. The rapid strides taken by China in space exploration have been the outcome of a deliberate and dedicated space programme. China has conceptualised space as the ultimate high ground to secure strategic and political gains in the future.[13] On October 15, 2003, China put its first person in space, the third country to achieve this feat. On June 16, 2012, the Shenzhou 9 spacecraft carrying three astronauts, including Liu Yang,

the first Chinese woman astronaut, docked with the Tiangong lab modules in space. The willingness of the US to work with China in space technology is a clear indicator that space dominance is just not a symbol of progress, pride or prestige, it is a power that China has acquired in the last twenty years.

In 2011, the Beijing based China's Information Office of the State Council released China's five-year space programme that listed major space activities to be completed by 2016. This includes establishment of a space lab, retrieval of lunar earth samples and work towards strengthening basic capacities of the space industry; acceleration of research on leading-edge technology, and continued implementation of important space scientific and technological projects such as human space flight, lunar exploration, high resolution earth observation system, satellite navigation and positioning system, and new generation launch vehicles.[14] By 2020, China is likely to have its own space station as also there is a strong possibility of a manned landing on the Moon in the same year.

### *Space Programmes of Japan and Russia*

Other space-faring nations such as the European Space Agency (ESA), Japan, etc are also pursuing many worthwhile space projects. ESA, an important space player, has many challenging and exciting missions on hand till 2020. The ADM-Aeolus, to be launched in 2013, will measure global wind profiles, Probe Bepi Colombo, a joint venture with JAXA (Japan Aerospace Exploration Agency) will head for Mercury, and Don Quixote, a space probe will be launched in 2013-15 to test deflecting of an asteroid. The ambitious Exo-Mars spacecraft and rover will start its journey for Mars in 2016.

Japan's progress in space exploration is a fine example for various countries that are struggling to make a mark outside the Earth. From 1969 to 1994, in 25 years, from no success in space technology to an emerging space power, Japan has the unique achievement of the launch of 30 rockets without a single failure. But, by 2004, Japan's space programme was reported to be undergoing a crisis of confidence and had a series of satellite and launcher failures.[15] According to FUTRON, Japan is losing competitive ground relative to most other space players. Policy reforms have helped in improving it but bigger benefits are likely accrue with more focus on commercialising its industrial base. JAXA has a busy 2013 and the years ahead. Apart from various joint ventures, it will launch ASTRO-H, an X-ray observatory in 2013. The climate observation satellite GCOM-C is scheduled to be launched in February 2014. JAXA scientists are also working on the IKAROS (Interplanetary Kite Craft Accelerated by Radiation of the Sun),

a small size powered solar sail experimental space craft. Future missions will use the solar sail for the Jupiter and Trojan asteroids exploration.

Russia has a history of military applications of space. In 2004, Russia had announced the formation of the Russian Military Space Force with a view to give space its requisite importance.[16] In April 2012, the Russian Space Agency came out with its future space strategy. Apart from improvement of space launch/ research related infrastructure like the new Vostochny launch centre by 2015 and a new generation rocket complex by 2020, the Russians have set a few tough targets for themselves. In the report, they have mentioned the development of new generation manned spacecraft by 2020. The Russian participation in international missions to Venus, Jupiter and asteroids has also been listed but without specific launch dates/ periods. Playing a key role in transporting astronauts and cargo to the International Space Station, Russia remains the world's launch leader.

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## Indian Space Programme: Inherent Strengths and Potential for Growth

India has been launching its own as well other nations' satellites since 1980 and has a number of satellites in orbit. Various space initiatives of ISRO that have captured the popular imagination have been outside the military realm, most notably, the Chandrayaan-1. The Annual Report 2011-12 issued by the Department of Space highlights the various activities undertaken by ISRO. Research and Development (R & D) in the space sciences and technologies and its application programmes for national interests have been acknowledged worldwide. ISRO has made remarkable progress in the fields of television and broadcasting, meteorology, education and societal application e.g. tele-medicine, tele-education and space-based imageries available through Indian Remote Sensing (IRS) programmes are being extensively used for management of natural resources. Indian satellite imageries are sold on a commercial basis around the world.[17] Antrix Corporation Limited, a government owned Indian company under the Department of Space has been marketing the space products

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and services in the global market. The major income is through distribution of Earth observation satellite data, transponder leasing services and the Polar Space Launch Vehicle (PSLV).

Another hallmark achieved by ISRO has been the designing and development of launch vehicles to put INSAT and IRS satellites into their orbits. Indigenous capability for design and development of satellite and associated technologies for communication, navigation, remote sensing and space sciences has given a new dimension to India's space adventures, and helped ISRO in becoming a front runner in extra-terrestrial research.

The NASA success story is somewhat emulated by ISRO in India, which can be equally inspirational to the world. The Chandrayaan-1 has been a grand success. The data it has sent has proved the presence of water on the Moon. It is now preparing to launch the Chandrayaan-2, a mission that will have an orbitter and a rover in the next couple of years. This will give a huge strategic advantage to the Indian space programme as China's Change-3 and NASA's LADEE are the only two other missions to the Moon planned in the near future. ISRO has also approved an orbitter mission to Mars, planned for launch next year.[18] Soon, ISRO will be launching ASTROSAT, India's first dedicated astronomy satellite. This satellite will be helpful in observing the multi-wavelength of the celestial bodies, cosmic sources in X-ray, visible and Ultra-Violet (UV) spectral bands simultaneously.

The challenge to undertake a mission to Mars seems to be nearing its realisation. Scientific payloads have been decided, baseline, solar array and reflector configuration of the satellite have been finalised and presently frequency filing for the communication sub-system is under progress. Scientists at ISRO are hopeful and planning to undertake a mission to Mars during 2013 to study life, climate, geology, origin, evolution and sustainability of life on the planet.

## Challenges to India's Space Endeavour

A lot has been achieved by ISRO in the last 43 years, but when compared with leaders in space technologies, there is still a lot to be done by India. Today, India has indigenous launch capability to access the low Earth, geo-stationary and sun-synchronous orbits but has limited ability to design and develop satellite components.[19] There are many factors that govern the speed of progress in this field. National motivations, regional rivalries and international challenges are

some of the key aspects that dictate the release of funds towards R&D in space exploitation. Budgetary constraints and strategic vision or mission for the space programme are synonyms for each other.

Keeping in mind the leading space-faring nations, India has a lot to achieve. The Indian human space flight programme is at the 'pre-investment studies' stage only and presently, ISRO doesn't have a clear roadmap for it. According to Krishnaswamy Kasturirangan, ISRO will have a clear roadmap in this regard once multiple phases of pre-investment studies reach a common final platform.[20] The Rs 425 crore, Indo-Russian venture, Chandrayaan-2, to be launched by a three stage Geo-Synchronous Satellite Launch Vehicle (GSLV) powered by an indigenous cryogenic engine (whose credibility is yet to be affirmed) is likely to be on mission by 2013/ 14. This timeline coincides with the launch of China's Change-3, a landing craft and rover on the Moon.[21] This parallel with China is indeed an achievement but a manual landing on the Moon by 2020 still remains a challenge. We need to think of the options on priority and address the issues in a well planned manner.

## Recommended Space Roadmap for India: 2020

Though it is true that what any nation can afford is at least partly a function of what it chooses to afford, development in any field bears considerable parallels with the country's economic growth, specially space technology that requires a huge annual budget for R&D.[22] China is an example of this: from having the world's sixth largest Gross Domestic Product (GDP) in 2003, it has overtaken France, UK, Germany and Japan by 2011. In its 12th Five-Year Plan, 2011-15, China has set a GDP growth rate target of 7 percent.[23] Seeing this rapid economic growth of China, analysts are almost sure that by 2019, China will be the world leader in terms of GDP.

Looking at the future, there are options that India/ ISRO can pursue. We can maintain a status quo i.e. keep moving with our current space programmes and commitments or, with the present budget allocation, make a realistic assessment and scale down our space commitments to have a balance between our ambitions and funding. We can also pursue a primarily civil/commercial focus, with increased funding and staffing for the programme. Another option that needs attention is pursuing a military/ intelligence focus for the programme.

One major area that has not been seriously addressed so far is taking the excitement and challenges of space technology to the younger generation at universities/ leading institutes of the country to ignite the fresh brains of inquisitive youngsters. There is a likelihood of involving students in the Chandrayaan-2 mission for data analysis, which will be a positive and fruit

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bearing step forward by ISRO. High budget requirements have an impact on aspirations. ISRO, being a leader in many space technologies, can be a useful and effective international partner in many high cost space missions. The expertise gained in the Chandrayaan series can be shared with other space-faring nations towards a successful international human landing on the Moon rather than holding back valuable research results due to budgetary limitations.

It is difficult to achieve bigger space goals on a single funding source. Present contributions are not sufficient to achieve bigger and faster goals in space. Learning from the US, we should also work towards privatisation of some well developed and established ISRO technological domains like communications and launch vehicles. A well balanced mix of government funding and outsourcing will not only help in overcoming the budgetary constraints but will go a long way in focussing the attention of ISRO scientists towards bigger and new future goals in outer space.

## Conclusion

The extraordinary success of the Mars Curiosity rover reflects and reinforces a far greater truth about space exploration! It requires dedicated commitment and an exceedingly high tolerance for failure.[24] There is no denial of the fact that in the present context, a country that effectively utilises space will have added prosperity and security. Robust, effective and efficient space capabilities will be an instrument to achieve the status of a global power. India has made its mark in space and its related technologies. There is an urgent need to persevere with the endeavour and explore other options to become a space leader in the times to come. The main reason that we venture into deep space is simply that we must. It is a necessity, not a frivolous whim, and a lust for science is not enough of an explanation, for we really don't know what we will learn on Mars. The Indian scientific and strategic community must explore for we want to learn what lies over the hill or around the corner. Inspiration, sweat, challenges, and dreams got us close to the Moon and they will get us to Mars and beyond. It is our destiny.[25]

## Notes

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