



REVIEW ARTICLE

INDO-FRENCH SPACE COOPERATION IN 21ST CENTURY

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ABSTRACT

Indo-French space cooperation has remained an important issue for many years among the scholars and strategic experts since independence. France was committed to overall development in India's science and technological field. From 1947 to 1991 France remained India's friend and not an ally. As a result relationship reached new heights. When India's exploded nuclear explosion France did not comment but rather signed strategic partnership with India. Under this coverage both the countries came together and collaborated in the field of space research. The paper is an attempt of better and cooperative understanding between India and France in the realm of space technological development.

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INTRODUCTION

Cooperation for the peaceful use of space has been significant feature of international politics for many years. States had shown keenness to use satellites for safe and low-cost communication networks, making reliable weather forecasts, managing natural resources, improving navigation and working for disaster management. Technology transfers and economic factors too play an important role in stimulating cooperation in the fields of space research. Such cooperation is more important to developing countries because it is an incentive to overcome scientific and technical backwardness. Hence, it becomes necessary for developing states to work in space research and to reap the benefits from various uses of space science and engineering achievements. The Indian political and scientific leadership also believed in peaceful use of space. In this arena, France is important for India. Indian Prime Minister Narendra Modi's visit to France in April 2015 could be seen as one step towards larger Indo-French engagement in outer space. The Indian Prime Minister Modi also visited the city of Toulouse, which is regarded as a hub for French / European aerospace research and industry. The visit to Toulouse gave Modi an insight of the European aerospace company, Airbus.

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In Toulouse, Modi also visited the French National Centre for Space Studies (CNES) and showed the country's willingness for further cooperation in the area of space. Overall, this recent political engagement is a clear indication that space will become an important area in the Indo-French cooperation.

A Space Collaboration between India and France

From 1960s onwards, the Indo-French partnership focussed constructive engagement. In this decade one such area of engagement was in the space area. Actually, space collaboration has not been taken seriously as compared to other aspects of national and international politics. The Indian space programme started by experimenting with sounding rockets in the early 1960s. The credit for India's space vision goes to Dr. Vikram Sarabhai. It was decided that its space programme would be non-military in nature. A brief history of this programme can be summed up as follows: The Indian Space Research Organisation (ISRO), was established in 1969. The first satellite mission launched was by ISRO was the Aryabhata Satellite on 19 April 1975. By 1980, India became a space-faring nation. India was a nation capable of launching satellites by using indigenously developed rocket technology. On 9 September 2012, ISRO successfully launched its 100th space mission. This mission was a commercial venture in joint collaboration with France and Japan. Today, ISRO can

undertake various project missions like multiple satellite launches in a single mission. ISRO has also successfully conducted missions to Moon (2008-09) and Mars (2013-14). Moreover, Chandrayan-1 was instrumental in finding the presence of water on the Moon. India's mission to Mars (MOM- Mars Orbiter Mission), has been of a successful case in frugal engineering.

So far Indo-French space collaboration was concerned it started in early 1960s. Both Dr. Vikram Sarabhai and Prof. J. Blamont of France were closely associated with the Indian efforts for the setting up of the UN-sponsored Equatorial Rocket Launching Station at Thumba, in the southern state of Kerala. (Rakesh Sood, 2015) Prof Blamont, the main architects of the French space programme, was the first Director of Science and Technology of the newly formed French space agency known as Centre National d'Etudes Spatiales (CNES, 1962). He spend much of his in nurturing space research in France and in fostering cooperation in this field with India. He was brain behind in starting the Indo-French space cooperation between the Department of Atomic Energy (DAE) and the CNES in 1964. The DAE was established in 1954. Besides various scientific activities, space was one of them undertaken by DAE. As such India is one of the oldest viable partners of France in the space arena. India was actually the CNES's second international partner in space after the United States. French scientists and industries played in instrumental role that helped India conceptualising its space programme in the initial years of its development. Scientists from both states also conducted a few joint scientific experiments during that period. CNES and DAE signed the first French-Indian space cooperation agreement on 15 May 1964. It covered licences to build Sud-Aviation's Belier and Centaure sounding rockets in India, with the accompanying transfer of solid-propulsion technologies. (Sud Aviation was approached for building simpler sounding rockets, 2015) Under the patronage of the United Nations and overseen by CNES, 50 French rockets were built locally and launched from 1965 onwards from the Thumba equatorial launch site. (www.ambafrance-in.org/IMG/pdf/cnes_mag_october_2014.pdf?11445)

Initially Indian scientists conducted experiments where some foreign sounding rockets were used. The credit for the establishment of India's sounding rocket programme was the possible with the assistance from the US and the USSR Rohini Sounding Rockets (RSR) Programme. India launched the first sounding rocket (Nike-Apache) on 21 November 1963. Subsequently, an indigenously build Indian sounding rockets was put into action as India received French assistance for both phases before the launch of Rohini programme and also for the Rohini programme's development. In 1967, the first rocket launched under the Rohini programme was a single stage solid propellant vehicle. India's solid propellant sounding rocket family uses indigenous rocket motors derived from French Belier / Jericho rocket engine technology. (www.astronautix.com/lvs/rh.htm) The Rohini programme is still operational today and ISRO currently uses RH-200, RH-300, and RH-300 Mk-II and RH-560 Mk-II rockets. In 1965 an agreement was reached with France for the transfer of the technology of the Centaure rocket, a two-stage sounding rocket. CNES supplied DAE with four Centaure rockets with payloads for vapour

cloud experiments. It was decided that the experimentation would be carried out through collaboration with Physical Research Laboratory (PRL) in India. Various other programmes like exchanges of scientists and engineers were put in place, while efforts were also made to engage the budding scientific community by facilitating admissions for Indian students in France. (Krishnamurthy, 2005)

Cooperation in the Space Sector

In 1969, ISRO was established as an independent space agency. This further boosted India-France cooperation. Emphasis was on assistance to develop space technology to India in multiple areas. France cooperation in space science and technologies were in multiple order and became part of various collaborative projects. It is beneficial to consider this relationship under specific segments. In 1972, CNES and ISRO signed a co-operation Protocol, which resulted in the establishment of the ISRO-CNES Joint Commission. Essentially, this joint commission was used to discuss the possibilities of collaboration in regards to satellite launch vehicles (SLVs) and communication satellites. (Nuclear Threat Initiative (NTI), 2012) The CNES-ISRO Cooperation protocol was further compounded by two Inter-governmental agreements, respectively signed in 1977 and in 1993. The 1993 agreement was more important because it included study of co-operative programmes in satellites and balloons for space research and applications. It was also instrumental in expanding the cooperation in the arenas of remote sensing, meteorology, communications and development of various other joint projects.

Indo- French programme received a major boost in 1998 when space was defined as a priority area of the newly launched strategic partnership between the two countries. From then on, India and France envisaged cooperation on joint satellite development. This bilateral relationship gained further momentum ten years later, when the Indo-French framework agreement was signed in September 2008, detailing a need to set up joint research programmes, instruments and launch satellites. This agreement mainly covered the areas of mutual cooperation as follows ([http://indembkwt.org/English% 2050% 20YEARS%20OF%20INDOFRENCH%20SPACE%20COOPERATION.pdf](http://indembkwt.org/English%2050%20YEARS%20OF%20INDOFRENCH%20SPACE%20COOPERATION.pdf)); study of climate change with earth observation satellites; development of micro-satellites and mini-satellites for scientific purposes; joint research and development activities; development of ground infrastructure for joint satellite missions; organization of combined training programmes; exchange of technical and scientific personnel. This agreement was taken when President Sarkozy's visited India and further progress was made in this area like developing the Megha-Tropiques and SARAL satellites. It has been recorded that both states would strengthen the scope of their exchanges and further develop their joint efforts in this field. On 5-6 February 2013, both India and France participated in the Science Seminar and Research and Technology Workshop organized in Bangalore and were keen to develop ambitious follow-on space cooperation proposals. Those plans were again included in the Joint Statement issued by India and France when President Hollande visited India on 14 February 2013.

In first official visit to France in April 2015, Indian Prime Minister Narendra Modi signed three MoUs concerning space issues. One such issue was MoU which laid stress on conceptualising a detailed programme between ISRO and CNES on the future course of action. This agreement would include cooperation in the areas of satellite remote sensing, satellite communications and satellite meteorology; space sciences and planetary exploration; data collection and location; operations of satellite ground stations and spacecraft mission management; space research and applications. The MoU covers potential cooperation activities such as joint earth observation missions, hosted payload opportunities and Mars exploration. (Modi in France: List of agreements signed, 2015) The two other MoUs were a two-year extension of the Megha-Tropiques satellite project and a Ka -band propagation experiment over Indian tropical region.

Launch Vehicles

ISRO's Polar Satellite Launch Vehicle (PSLV) is regarded as one of the major achievements of ISRO. PSLV, a four-stage rocket has been developed and operated by ISRO. In March 2015, it has made 29 launches and conducted 27 consecutive successful missions. This rocket has been used even for launching its Moon and Mars missions. The involvement of France is great because in the second stage (which is a liquid stage) of PSLV, it uses an engine. ISRO obtained liquid engine technology with the assistance of the French the Société Européenne de Propulsion which is Europe's largest producer of liquid propulsion engines. It gave ISRO the technology in return for India's help in developing the French liquid engine -- the Viking -- and for the parts it made for the Ariane rocket. (Countdown to self-reliance, 1993) In February 2013, India successfully launched its PSLV-C20 mission. It was a 409-kilogram payload satellite named SARAL (Satellite for ARGOS-3 and ALTika). The purpose of SARAL is its oceanographic utility to study the circulation of ocean currents and measure ocean surface topography. The information is important to predict the weather condition in the short-term and climate change in the long-term. This satellite has two independent payloads and it has been developed by the French space agency CNES: Argos-3 for data collection. It is also a platform for collecting data from ocean buoys and weather data centres and Altika altimeter (radar altimeter) for ocean surface topography (study sea surface altitude), operating at high frequency Ka band. The data collected from the SARAL is then incorporated into the French programme of operational oceanography development. The collected data has also contributed to the Global Ocean Data Assimilation Experiment (GODAE), the first international operational oceanography experiment. SARAL has similar role as compared to ISRO's Oceansat-2. This satellite was launched in September 2009. The objective was to study surface winds and ocean surface strata. The inputs provided by this satellite assisted NASA for monitoring the Hurricane Sandy. (This super-storm Sandy, 2012)

Accepting the importance of space programme, ISRO, CNES and ONERA (the French Aerospace Research Agency) signed a MoU in April 2015 for Ka -band propagation experiment over the Indian tropical region. The main purpose is the collection of Ka -Band attenuation data which is capable of

using available Ka - Band transmission and performing analysis along with corresponding radiometer and meteorological data. Besides these efforts, ISRO is also involved with France in manufacturing custom-made satellites for various clients. An advanced communication satellite HYLAS (Highly Adaptable Satellite) was developed by ISRO on a viable business basis in partnership with EADS-Astrium of Europe. It was successfully launched on 27 November 2010 by the European Ariane-5 V198 launch vehicle. This HYLAS satellite, which has been developed for Avanti Communications, UK, comprise of ten high-power transponders that could use eight in Ka and two in Ku band frequencies. The contract for developing the satellite was signed in 2006, after competing with United States and Europe, through the strategic alliance worked out between Antrix/ISRO and EADS Astrium of France.

The alliance was formed in early 2006 to jointly develop communication satellites with ISRO platforms and Astrium payloads and market them internationally. (ISRO, 2010) This alliance between Antrix/ISRO and EADS Astrium has also led to the development of a satellite called W2M. This satellite is so far the heaviest spacecraft built by ISRO. It weighs 3,462 kg at liftoff and was launched on 20 December 2008 for the operator Eutelsat. Under the W2M contract, EADS Astrium was the prime contractor in charge of the overall programme management. While EADS Astrium built the communication payload, Antrix/ISRO built the satellite bus, and integrated and tested the spacecraft. (ISRO makes \$40 mn profit out of W2M satellite, 2008) This satellite had to face problems in the initial period because of the partial failure with its power system. Since, then it is functioning normally and is expected to operate till 2020.

Mutual Trust

India's space programme, had to be dependent on foreign sources for various components. France provided a variety of technical assistance to India. In particular, France played a more positive role in assisting India to develop its ground and space infrastructure, launching platforms and human resources. It was seen that these aspects of the Indo-French relationship were not based on any form of exploitation by France. India reliance on France was mainly for technological assistance. It seems that the overall French policy was not to make India's space 'dependent' solely on them, but permit India also to experiment, discover and develop on its own. In other words, the role was to make self-reliant. For instance, the Franco-German satellite SYMPHONIE was placed above the Indian Ocean arch from 1977 to 1979. In this way, it permitted ISRO to gain experience in space telecommunication systems by conducting a series of innovative communications experiments. When India exploded its first nuclear weapon on 18 May 1974 (Pokhran-1) sanctions were imposed on India so that members would not sell or give any technological assistance that would further enhance Indian Space Programme. In 1980s India had by then become a space-faring state and would make further progress both in launching platforms and satellite manufacturing. In the early 1990s, India was derived the technology to be provided by Russia for the development of cryogenic engine because USA prevented the Russia to do so.

The US apprehension was based on the fact India could use such technology to develop missiles and hence giving technology to India would amount to violation of MTCR (Missile Technology Control Regime) guidelines. When, India conducted its second nuclear tests (Pokhran-II) in 1998 fresh sanctions were put on the country. Overall, India remained under the sanctions regime for more than three decades. In spite of all these development France's commitments were firm and even signed the strategic partnership with India. France then assisted and cooperated with the Indian space agency in every possible manner. Even the French firms like Thompson-CSF appeared to have supplied ISRO electronic components during this difficult phase.

Thus, France became the most dependable partner of India in the field of space. Though there was Indo-French cooperation in 1970s and 1980s but it gained importance with the strategic partnership agreement of January 1998. From then relationship was more vibrant. Now, after five decades of cooperation, it is clear that the space segment has been instrumental in taking the Indo-French strategic partnership to new heights. Pragmatism has been the key for this relationship. Nevertheless, in the space sector, India and France have made ample progress by highlighting each other's requirements while highlighting their mutual 'strengths'. The basic reasons for the success has been the political engagement from both sides. What is more important that the overall bilateral relationship has always been accommodative. This has helped India in taking the space agenda forward. There has been appreciation of the efforts put in by the scientific community in both states. Dr. K Kasturirangan, Chairman ISRO (1994 to 2003) is recipient of the French Officer de Legion d'Honneur for his outstanding contribution to India's space missions and promoting scientific cooperation (2002). On the occasion of the 66th Republic Day Celebrations on 26 January 2015, Prof. Jacques Blamont was conferred the Padma Shri, one of the highest civilian honours of India, for his distinguished service in the field of science. He had taken part in November 1963 in the launch of the first rocket from India and was invited, 40 years later, to the celebrations held in Thiruvananthapuram to mark the 40 years of the Indian Space Programme. (ISRO, 2010)

The Recent Development of the Indo-French Partnership

With the beginning of 21st century, satellite development has emerged as a new area for collaboration between India and France. In this field, ISRO contribution in developing satellites and providing launching services cannot be ignored. In some cases, ISRO has manufactured satellites for European clients too. The purpose of collaboration with foreign powers have been more on designing a system, which could provide data required for meteorological purposes. Presently, Megha-Tropiques has made its data available free of cost. This could be seen as significant step made by both India and France on tackling the challenges of climate change. Moreover France's assistance in developing India's most reliable launch vehicle, the PSLV, it could be assessed that France has been associated with the overall success of India's space programme. Moreover, a commercial Launch Service Agreement has been successfully put in place amongst the agencies of both states. In spite of French assistance, Indian contribution cannot be

ignored. It indicates that ISRO has developed a very reliable launch system and country like France are well aware of their capabilities and that is why they are offering satellite-launching contracts to them.

Conclusion

It is interesting to comment that Indo-French relationship has remained restricted to identify space as an instrument for socioeconomic development. Both have worked together towards developing programmes that could have social, scientific or commercial values. However, no major efforts have been made to join hands in various multilateral groupings addressing outer space issues. It is also important to note that both have contributed by consenting mutual agreeable 'point of view' in various UN bodies debating space issues. No structured discussion appears to have happened amongst these two states on issues like the proposed International Space Code of Conduct.

On issues related to space security, France being a part of Europe but it has expanded its discussions to India on these critical areas. Both are against space weaponisation and join hands together in canvassing a space treaty mechanism. Today, in order to tackle the problem of space debris menace effectively, there is much need for the evolution of a global Space Situational Awareness (SSA) network. Though France has good expertise in telemetry and tracking devices and radar systems, France should along with India and other countries come together and work for global SSA network. Defence is one area where no interaction is seen amongst India and France towards recognizing space as an important element of security architecture. But what is important India and France should jointly develop and deploy spy satellites for the purpose of gathering intelligence for counterterrorism operations. During the April 2015 visit to France of Indian Prime Minister Narendra Modi, the Mars mission was identified as one area for future cooperation. Overall, cooperation and collaboration between India and France in the outer space sphere has proved to be mutually beneficial. Today, there is much trust between them and success for this has the political engagement. Again it needs to stress that overall bilateral relationship should be accommodative. Now, both the countries should move ahead and take this collaboration to the next stage to gain more scientific, strategic and commercial benefits.

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