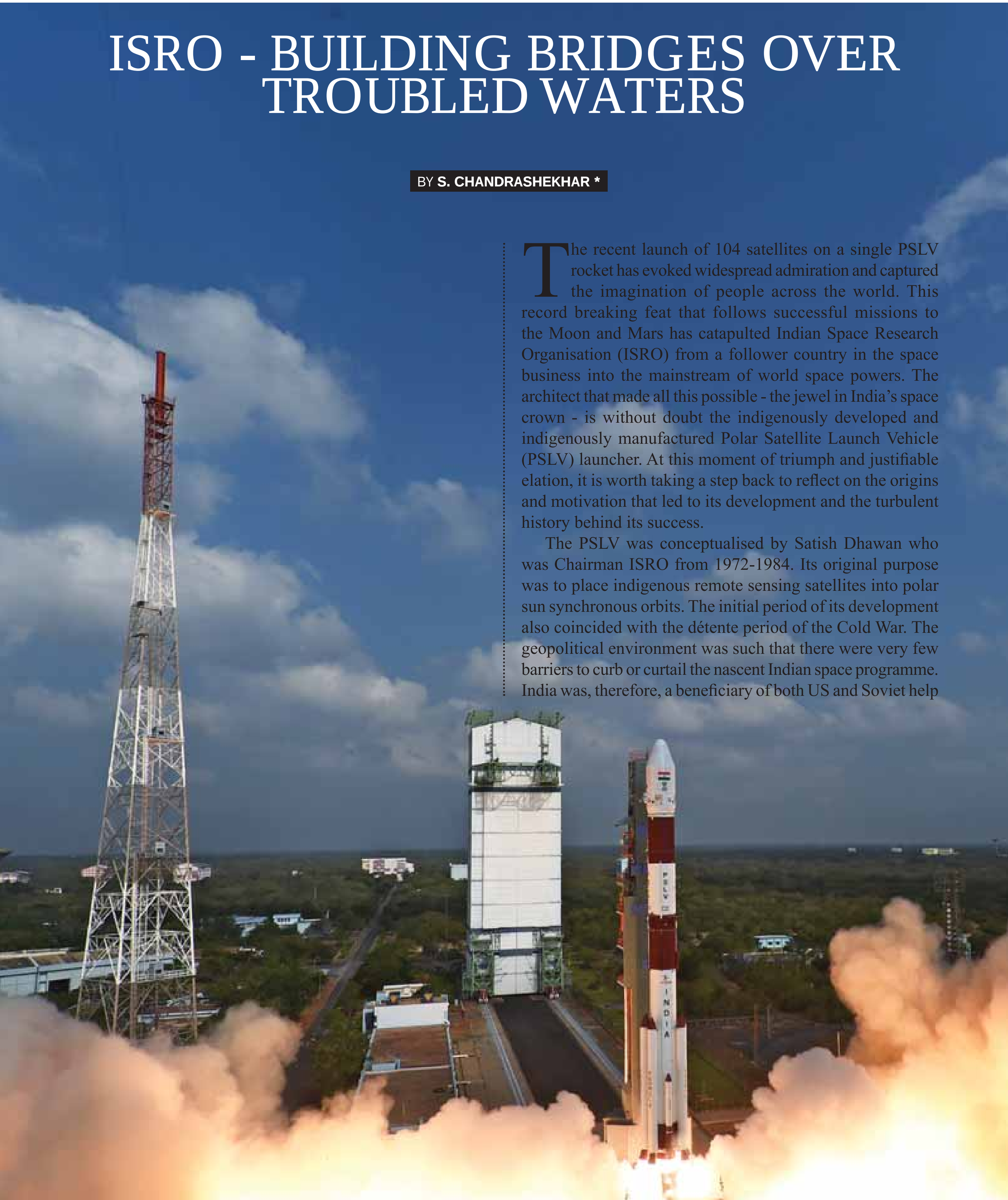
ISRO - BUILDING BRIDGES OVER TROUBLED WATERS

BY **S. CHANDRASHEKHAR ***



The recent launch of 104 satellites on a single PSLV rocket has evoked widespread admiration and captured the imagination of people across the world. This record breaking feat that follows successful missions to the Moon and Mars has catapulted Indian Space Research Organisation (ISRO) from a follower country in the space business into the mainstream of world space powers. The architect that made all this possible - the jewel in India's space crown - is without doubt the indigenously developed and indigenously manufactured Polar Satellite Launch Vehicle (PSLV) launcher. At this moment of triumph and justifiable elation, it is worth taking a step back to reflect on the origins and motivation that led to its development and the turbulent history behind its success.

The PSLV was conceptualised by Satish Dhawan who was Chairman ISRO from 1972-1984. Its original purpose was to place indigenous remote sensing satellites into polar sun synchronous orbits. The initial period of its development also coincided with the détente period of the Cold War. The geopolitical environment was such that there were very few barriers to curb or curtail the nascent Indian space programme. India was, therefore, a beneficiary of both US and Soviet help

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for its space efforts. Also Europe, especially France was very supportive. The transfer of Viking engine technology for the manufacture of liquid engines to ISRO from France happened during this period. The terms and conditions under which this transfer took place were possibly unique to that time and place. It is difficult to visualise a recurrence of this kind of arrangement in the current world order. It was a tribute to the visionary leadership of Dhawan and the political setup of the country that even before the PSLV had been conceptualised they went ahead with the acquisition of a key technology that would be needed for the future PSLV.

Other major projects such as SITE (US supported), STEP (Europe supported), Aryabhata and Bhaskara launched by the Soviet Union free of cost, APPLE launched by ESA free of cost, helped ISRO develop the technological and organisational capabilities to build complex space systems. These were the heydays of the 'sanctuary regime' in space that ISRO successfully navigated in order to acquire the required competences.

Bottlenecks in the foreign procurement of key components and materials required for the building of both satellites and rockets became visible in the early 1980s. As the PSLV moved into its final phases of development, the US-led Missile Technology Control Regime (MTCR) came into force creating additional barriers for the speedy realisation of the project. These constraints on foreign procurement forced ISRO to come up with original approaches to resolve many technical issues that it faced. The development of the crucial fourth stage of the PSLV with restart capabilities needed to place the 104 satellites in orbit went through its trial by fire before it was finally certified for use. As a consequence, the original purpose of creating a strong indigenous base for the development and production of launchers required for the space programme was reinforced several fold. The PSLV architecture represents an original, India designed and India manufactured product. This has helped successive generations of engineers to progressively improve its capabilities to meet various mission requirements.

Though embargo regimes imposed mainly by the US also affected the satellite programme, its effects were not as serious or as pronounced as in the launcher area. Commercial considerations as the Indian programme expanded in scope and scale also played a role in moderating the effects of sanctions and control regimes as ISRO turned towards indigenous development or other suppliers for meeting its needs. As the PSLV moved into its operational phase in the early 1990s, the world space order went through yet another upheaval with the demise of the Soviet Union. The rise of China as a world power, the first Gulf war in which space-based US assets played a major role in winning a conventional war, and US-led developments on Ballistic Missile Defence (BMD) created new complications. The sanctuary regime gave way to a more antagonistic space order.

The 1995-96 Taiwan straits crisis resulted in a major military modernisation response from China that involved significant investments in space-based assets. These Chinese actions can be seen as asymmetric moves aimed at the vulnerabilities of a dominant US. It includes the development of space-based C4ISR satellites, Anti-Ship Ballistic and Cruise missiles that target Aircraft Carrier Groups (ACG) as well as Anti-Satellite (ASAT) weapons that can attack US satellites. China's Anti Access/Area Denial (A2AD) strategy that is based on these demonstrated capabilities can be seen as a Chinese counter to US actions that threaten China's core interests such as Taiwan. These moves and counter moves by the two major space powers are transforming the use of space. Any conventional war or even a limited engagement between China, the US and its allies in the Asia Pacific theatre could have direct as well as spillover effects into space. Nuclear war, conventional war and space-based assets are closely intertwined with war and the war deterrence strategies of the major world powers. This is the reality of today's geopolitical landscape.

The continuing US ban on space trade with China has also had a major impact on Chinese efforts to enter the global market for space products and services. These embargos have forced China closer to Europe and Russia. It has also significantly strengthened China's internal capabilities to build indigenous satellites without any US parts. China can today build low cost large state-of-art communications satellites and deliver them in orbit to international customers. Chinese commercialisation efforts in communications, navigation, weather and remote sensing have all made substantial progress. They will directly threaten US and European interests. Launch services, the GPS standard, US dominated services such as Google Earth, weather information and a whole host of application-based services will be subject to increasing competition from cheaper Chinese alternatives.

These global developments have also had a major impact on India's space programme especially with regard to its development of the Geosynchronous Satellite Launch Vehicle (GSLV). Just before Dhawan retired, ISRO leadership had planned the development of the GSLV successor to the PSLV. The configuration of the GSLV involved using the main stages developed for the PSLV along with a high energy liquid hydrogen liquid oxygen based cryogenic upper stage to place needed communications satellite in Geostationary Orbit (GSO). ISRO had to decide whether to develop the needed cryogenic stage or to buy the technology from outside. Buying the technology from outside came with a risk of US sanctions under MTCR. ISRO explored all available options for sourcing cryogenic engine technology. The three main supplier countries - the US, France and Japan all turned down ISRO's request. Even the French who had always been open about doing business with India were not keen on creating a potential competitor to their Ariane launcher. Just as ISRO was embarking upon the indigenous development route for the cryogenic engine, the GSLV Russia came up with a very attractive offer to transfer cryogenic engine technology to India.

The ISRO decision to take up the Russian offer ran into problems almost immediately. As one would have expected, US pressure on Russia forced them to go back on the agreement. As a consequence, ISRO has had to grapple with a host of technology and scale up problems. Unlike the PSLV project that took about 10 years, the GSLV has been under development for more than 20 years. Recently, ISRO has at last achieved continuing success with two successful tests. The GSLV Mark 2 version may become operational soon. ISRO is also developing a bigger GSLV Mark 3 launcher using an indigenously developed cryogenic engine that can lift heavier satellites to GSO. This is in the final stages of development.

Though PSLV is an undoubted success, it can only cater to a niche segment in the global launch services market. India needs a more powerful GSLV launcher to cater to both its domestic needs as well to meet the needs of the global market for larger communications satellites. As the world moves towards the increasing militarisation of space, India may also need to develop capabilities for coping with these developments. These demands will need a bigger launcher. A bigger launcher would also enable ISRO to undertake innovative missions for exploration of the solar system and other celestial bodies.

These two contrasting illustrations of the PSLV and GSLV projects and their trials and tribulations provide us with an understanding of how global geopolitical developments can impact any hi tech endeavour in the country. The Dhawan era was characterised by a more benign global order in which many things were possible for a nascent space power. Today's environment is much more complex with geopolitical, economic and business considerations all affecting how companies and countries engage in mutually beneficial activities. Strong lobbies, powerful political interests, the personal aspirations and idiosyncrasies of leaders a la Trump also have a role to play in influencing the relationships between countries. Recent ISRO chairmen face major hurdles and bottlenecks in trying to navigate their way through this complex maze of coupled connections.

These are the realities of the international space order that India has to contend with as it moves towards becoming a major player in the space business. While at the macro level, the increasing US China rivalry will strengthen India's ties with the US, at the micro level of competition in the commercial market, there are likely to be a number of irritants in the relationship between the two countries. Moves in the US Congress to impose restrictions on the use of PSLV for the launching of US satellites are already evident. The US could at any time impose such restrictions on the launching of satellites with US parts by the PSLV and the GSLV. The ongoing weaponisation of space will also need appropriate technical responses from India. The scale of India's space activities needs to increase several fold to cater to these growing needs. The debris problem and the small satellite revolution will add to the congestion in space. India will have to do its share not only to alleviate international concerns, but also to manage its space assets wisely.

As the global space power games evolve, they will have a cascading effect on the threats and opportunities that the Indian programme will encounter. While opportunities can be exploited suitably, the obvious lessons that can be learned from the PSLV and GSLV experiences is that key areas of development have to be shielded from the vagaries of global power politics. A closer coordination of activities between different arms of the government, the creation of competing capabilities in Indian industry, a clear recognition that India also needs military assets in space and a major expansion in the scale and scope of the programme with clear goals appear to be obvious actions that India should take.

The lessons that India and ISRO have learned from the PSLV and GSLV experiences should stand them in good stead as they look ahead to the future. After all we do live in interesting times and space promises to be most interesting. ■

** The writer is Visiting Professor, National Institute of Advanced Studies, Bengaluru and has spent more than 20 years working at ISRO.*