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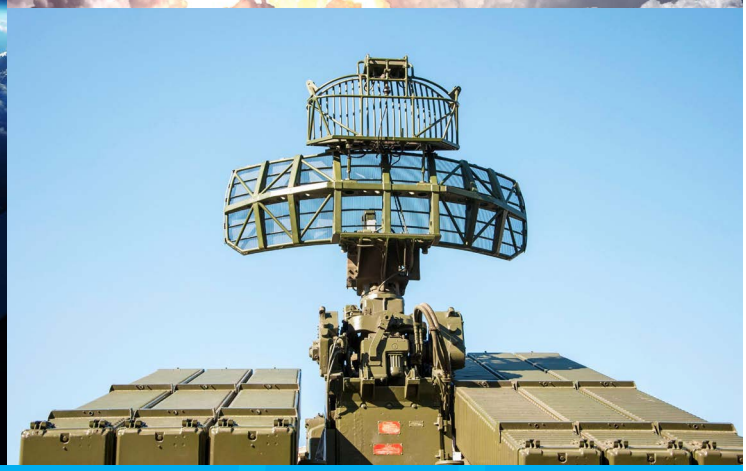

SELF RELIANCE IN DEFENCE SPACE

Inclusion of Space Sector in Discharge of Defence Offset Obligation

रक्षा क्षेत्र में अंतरिक्ष संबंधित आत्मनिर्भरता

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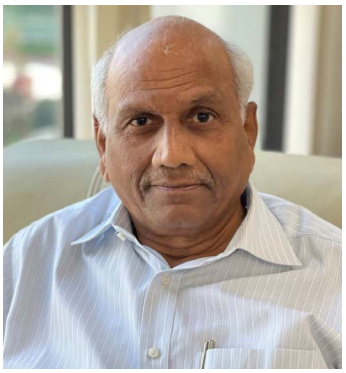

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The space-based capabilities are critical for adding a strategic depth to India's defence preparedness. Military and Defence establishments worldwide have steadily increased reliance on critical space assets for communication, imagery, navigation, signal/electronic intelligence, early warning and meteorology etc. across a wide range of satellite size, constellations and orbits

The emergence of the commercial space sector and start-ups in India and the potential to leverage their capabilities, throws up some attractive possibilities for the country's defence requirements. The Space ecosystem in India has the potential to contribute to the modern Defence needs, both in times of peace and conflict, which consist of several space solutions critical for intelligence, such as High-resolution imagery, surveillance and reconnaissance, besides navigation and communication. At the same time India also need a robust strategy to develop India's counter-space capabilities. Many top space-faring nations have already placed labs in space and have demonstrated the most advanced counter-space capabilities. This requires the existing space industry capabilities to be enhanced in scale and maturity for defence needs.

The sectors together can gain immensely from cross-industry collaborative policies between Space and Defence, aiding the objective of Aatmnirbharta in defence procurement of space capabilities. The sectors can naturally benefit not just with scale but also mature industrial capabilities, research, technologies, processes and cross-pollination of ideas. They can combine existing technologies in a more prolific manner and lead to the development of state-of-the-art applications and catalyse the indigenous industrial capability in a more cost-effective manner and with better commercial traction.

The Space sector being the 'Fourth Frontier' of Defence, the inclusion of space sector in discharge of offset obligations can be a major catalyst for both sectors. Defence and Space sectors both target to achieve a $25 Bn and $50 Bn market by 2025 and 2030, respectively with a similar growth trajectory of 17% compounded annual growth rate. Sourcing of space equipment and services-including sounding rockets, components, subsystems etc. from the Indian private industry and launch services of foreign satellites through ISRO's PSLV/GSLV, should be made eligible to meet offset obligation.

Such measures will leverage the synergies between defence and space industries both in enhancing indigenous manufacturing capabilities, cut down the imports and achieve the export target of the government. This would also open a new avenue for foreign OEMs in discharging of their offset obligations.

The space and defence sector need a well-articulated and transparent offset policy that can create genuine advantages to make both the sector self-sufficient, cut down heavy imports and would potentially open the export market.

Message by Director General SIA-India

Anil Prakash
Director General, SIA-India

In the new era, Space communications and technology are playing a much more significant role in defence strategies, in disaster management and supporting economies. The reliance is so significant, so is the need to safeguard the space assets. Space defence has become a high priority as more and more countries intensify their dependence on space systems for both their economic and military security.

In India, ISRO has coordinated its military and civilian space programs since the 1960s. ISRO built and launched dedicated military communications satellites such as GSAT-7 (2013) for the Navy and GSAT-6 (2015) for armed forces.

In 2019, India took big technological and institutional steps toward marshalling a globally competitive space warfare capability. India conducted its first Space warfare test in 2019, called IndSpaceEx as part of the assessment of threats and the creation of a Joint Space Warfare Doctrine. The test exercise placed India at par with China, Russia, and the United States in terms of achieving a practical anti-satellite capability.

As India took a closer look at the emerging space security challenges to acquiring appropriate defence capabilities in space, it established two new bureaucracies for space, the Defence Space Research Agency (DSRA) and the Defence Space Agency (DSA). The DSA formulates strategies integrating space assets from the army, navy, and air force to protect India's interests in space including addressing space-based threats and is supported by the DSRA whose functional responsibility is to provide technical and scientific expertise.

Space being the 4th frontier of Defence, Space-based capabilities will form a significant proportion of defence procurements in near future and when properly planned and coordinated, space operations would enable and support unified action. The Government of India's decision to open the Space domain to private and foreign enterprises is a positive step and opens up several additional avenues to build strategic capacity and capability. As India's space sector activities take full speed, it is important that the efforts of the Ministry of Defence to bolster the Indigenous Industrial capability towards "Atmanirbhar Bharat" for procurements, need to extend to space based capabilities as well.

The emergence of the commercial space sector and startups in India and the potential to leverage their capabilities throw up some attractive possibilities for the country's defence requirements in the discharge of offset obligations. Sourcing of space equipments and services should be made eligible to meet offset obligations.

Leveraging the synergies between defence and space industries would not only help foreign OEMs in discharging their obligations by opening up new avenues for discharge. It will also give a significant boost to manufacturing sector and exports as well as cut down on heavy import bills.

India, therefore, needs to craft a strategic space defence policy where the strengths of both the sectors can mutually benefit each other.

The SIA-India position paper urges the Ministry of Defence to bring the space manufacturing sector under 'Offset Policy' with a supporting strategy and approach. The paper highlights how the unique capabilities of space operations will bring a strategic depth in Defence Affairs and would leverage space power for exploitation of space to enhance defence capabilities and protection of our national space assets.

The Government has set the defence production target at $25 Bn by 2025 and the Space sector in India aspires to become a $50 Bn market by 2030, the targets are ambitious and need a timely facilitating policy decision. SIA-India aspires to play an active role in this direction.

"Space bestows immense force multiplication capability on the Armed Forces, and the dependence on space assets for military operation is rapidly increasing. Currently, India's space capabilities are mostly driven by civil and commercial requirements, steps for exploitation of space for military applications are being undertaken. Leveraging space power would include protection of our National space assets and exploitation of space to enable defence capabilities across the conflict spectrum."- Extract from Joint Doctrine Indian Armed Forces.

Executive Summary

Space as a domain will have a significant role in how terrestrial conflicts play out in the future by connecting the operational capabilities of a nation in the traditional operational theatres of land, air and sea. Modern air, naval and ground operations are heavily invested and reliant on space assets for terrestrial missions. As the fourth dimension of warfare, the space industry provides the required Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance [C4ISR] capabilities across theatres of command and operations. In the past decade ISRO's satellite capabilities have catered to the needs of the Armed Forces such as battlefield communications and cross-border surveillance.

The upcoming combat zones will be shaped by state-of-the-art technology, where technological superiority and dominance will determine the outcome of these future battles. Technological self-reliance is a key, and a collective national effort needs to be initiated ensuring that technological developments are in line with our desired military capability. The Ministry of Defence recognises that progress needs to be accelerated by harnessing our national capability in all its forms.

The space-based capabilities are critical for adding a strategic depth to India's defence preparedness, both in times of peace and conflict. Active measures are needed to be in place to ensure the space assets are not only functional but also well protected to safeguard the political, military and economic national Interests.

A common characteristic to developing the defence and space sector capabilities are that they are both cost and time-intensive, challenged by the race to keep up with the relentless march of technology. It is therefore imperative that the long-term requirement of capabilities be identified and understood for appropriate technology to be developed indigenously.

The award of 74% of contracts by Indian Army to Indian vendors in 2020-21[1], is a great move towards encouraging indigenous manufacturing and making India a manufacturing hub under the Government's 'Make in India' and 'Self Reliant Bharat' policies. Space related capabilities will form a significant proportion of defence procurements in near future. The efforts of the Ministry of Defence to bolster the Indigenous Industrial capability towards "Atmanirbhar Bharat" for procurements needs to extend to space based capability as well.

This requires the existing space industry capabilities to be enhanced in scale and maturity for defence needs. The highly successful Indian Space program encompassing PSLV to satellites, payloads, ground segment

1 https://www.makeinindia.com/sector/defence-manufacturing

has largely been driven by civilian and commercial applications. The industry has played a significant role in these programs with 120 companies participating in project 'Mangalyaan' and over 80% of PSLV being contributed by the private sector. This has in turn also helped the nation build industry capabilities that can be exploited for defence needs and exports.

The emergence of the commercial space sector and startups in India and the potential to leverage their capabilities, throws up some attractive possibilities for the country's defence requirements. Civil-Military Fusion leverages private sector firms to reduce the cost of satellite sensors that enhances SIGINT encompassing COMINT and ELINT including the development of satellite constellations.

Defence and Space sectors target to achieve a $25 Bn[2] and $50 Bn[3] market by 2025 and 2030, respectively. With the current Indian share that is just 2% of the global space economy, there is an immense potential to capture a place in the strategic supply chain globally that will also help the nation to achieve its export target of $1 Bn. Requisite measures that allow the space industry to meet the defence procurement needs, and in the process enhancing scale and maturity of related industrial capability, accelerate the journey towards this objective.

A key measure that could be a game-changer for the defence and space sectors relates to the discharge of offset obligations. Sourcing of space equipment and services- including sounding rockets, components, subsystems etc., from the Indian private industry and launch services of foreign satellites through ISRO's PSLV/GSLV, should be made eligible to meet offset obligations.

- Such a measure will propel the Indian space industry to achieve economies of scale and continuity, beyond their participation in the National space programs of ISRO.
- Leveraging the synergies between defence and space industries could help foreign OEMs in discharging their obligations by opening up new avenues for discharge. Currently of the $12 Bn offset obligations, only $5 Bn has been discharged.
- This measure could also potentially open up the export market and help India meet the export target of $1 Tn by 2025.

The Space sector being the 'Fourth Frontier' of defence, the inclusion of space sector in discharge of offset obligations could be a major catalyst for both the sectors.

Space Power will bring a Strategic Depth in Defence Affairs

The defence capabilities can be augmented with satellite capabilities, for which Space and Defence sectors in India need to work inter-se and provide complementary support to each other.

Space assets add an immense strategic depth to the defence capabilities of the nation. Military and Defence organisations worldwide have steadily increased reliance on critical space assets which includes applications ranging from communication, imagery, navigation, signal/electronic intelligence, early warning and meteorology etc. across a wide range of satellite size, constellations and orbits.

The unique capabilities of space operations bring some distinct advantages to support operations, whether military, civil or commercial, such as:

1. Not Constrained by International Laws: Space operations are not restricted by political geography as the international law does not extend a nation's

territorial boundaries into space. This characteristic makes space-based Intelligence, surveillance, target acquisition, and reconnaissance [ISR], remote sensing, SATCOM and Positioning, Navigation and Timing [PNT] have a wider reach when compared to terrestrial alternatives.

2. The Ultimate High Ground: Geosynchronous Earth Orbit (GEO) satellites can view 42% of the Earth's surface area. Space affords a global vantage point from which to assess large masses of the land, oceans and air to serve strategic, operational and tactical objectives. Even the LEO/MEO satellites have fields of view spanning hundreds of miles due to which space can be termed as the 'Ultimate High Ground'.

3. Responsiveness. With the current state of technology, space resources can be rapidly reallocated to the areas where they are needed most, providing the ability to bolster communications or ISR capabilities, on much faster timescales than ground-based or airborne capabilities.

4. Multi-User Capacity. Space operations typically support multiple users and, in some cases, such as PNT, can provide service to an unlimited number of users. The defence forces can have access to shared advantages generated in space nearly anywhere on the globe, in near real time.

5. Speed, Reach, and Persistence. A spacecraft's orbital parameters (e.g., velocity, distance and inclination) enable satellites to overfly vast areas in very short periods, allow rapid revisits and persistent coverage.

The immense force-multiplication capability that space offers, for the Armed Forces, is beyond question. In India, steps undertaken for exploitation of space for military applications will shape the nation's space industry that has been mostly driven by civil and commercial requirements till now. The defence capabilities can be augmented with satellite capabilities, for which Space and Defence sectors need to work inter-se and provide complementary support to each other.

Leveraging space power would include exploitation of space to enhance defence capabilities and protection of our national space assets.

Modern defence sector needs would consist of several space solutions critical for intelligence, such as high-resolution imagery, surveillance and reconnaissance, besides navigation and communication. Space assets are critical for terrestrial missions during conventional battles, strategic targeting of enemy capabilities and covert operations by Special Forces. The outcome of tomorrow's conflicts will be driven by military planning and execution integrating space capabilities in overall strategy. The Armenia-Azerbaijan conflict of 2020 has shown how cost-effective technology can actually win over capital-intensive warfare system.[4]

Space assets play a vital role in advancement of C4ISR capabilities and better situational awareness. The role of space-based C4ISR assets is complemented by other ground-based components. The importance of space systems in delivering NLOS communications for Command and Control to man and machine beyond the horizon is irreplaceable. Satellites provide critical sensor information through revisit rates over specific areas of interest, both during times of peace and conflict. Space-based sensors will continue to provide platforms for global observation that are more difficult to disrupt, degrade and deny than similar sensors in other domains.

An example of a peacetime use is the recently surveyed 17.78 lakh acres of defence land by the Directorate General, Defence Estates [DGDE] using the latest technologies such as Electronic Total Station, Differential Global Positioning System, Drone and Satellite imageries.[5] The mammoth exercise was started in October

4 https://www.washingtonpost.com/world/europe/nagorno-karabkah-drones-azerbaijan-aremenia/2020/11/11/441bcbd2-193d-11eb-8bda-814ca56e138b_story.html

5 https://www.thehindu.com/news/national/dgde-completes-surveying-1778-lakh-acres-of-defence-land-rajnath-awardspersonnel/article38406726.ece#:~:text=The%20Directorate%20General%20Defence%20Estates,Estates%20Offices%20and%20four%20Assistant

2018. Developing surveillance systems through satellites, to monitor the changes in the ground to take any corrective actions in case of any violations or encroachments is critical and as per the best practices followed globally.

Leveraging space power would include exploitation of space to enhance defence capabilities and protection of our national space assets. India needs to boost its indigenous capabilities to observe, track and identify objects in outer space. There would be an urgent need for measures and prompt actions from the policymakers to protect Indian interests in outer space and deal with potential conflicts. Indian Chief of the Air Staff Air Chief Marshal V R Chaudhari recently said, "China's latest demonstration of physically moving one of its disabled satellites into the graveyard orbit is bringing in newer threats in the race to weaponise the space domain, a domain hitherto considered relatively safe."[6]

Considering the emerging challenges with the growing space activities over the past few years, the Tri-Services Defence Space Agency (DSA) has been created for enhancing leverage of the Space domain for military purposes, adding a new dimension to the traditional 'triad' of Land, Sea and Air. The agency is tasked to command the space assets of the Army, Navy and Air Force, in conjunction with ISRO, DoS and DRDO, and operate the space-warfare and Satellite Intelligence assets.

Civilian and military satellite systems are dual-use technologies indistinguishable from one another. There is a need for India to craft a strategic space policy and doctrine without which it will not be possible to shift the focus from civil to military use of space.

The DSA formulates strategy to protect India's interests in space including addressing space-based threats and is supported by the Defence Space Research Agency (DSRA) that has the functional responsibility to provide technical and scientific expertise as well as develop assets for the Agency. When properly planned and coordinated, space operations enable and support unified action.

India conducted its first Space warfare exercise in 2019, called IndSpaceEx as part of the assessment of threats and the creation of a Joint Space Warfare Doctrine. This enabled us to take a closer look at the emerging space security challenges which helps in acquiring appropriate defence capabilities in space. An important takeaway from IndSpaceEx is the need for India to craft a strategic space policy and doctrine without which it will not be possible to shift the focus from civil to military use of space. After all, civilian and military satellite systems are dual-use technologies indistinguishable from one another.

6 https://economictimes.indiatimes.com/news/defence/chinas-demonstration-of-physically-moving-disabled-satellite-to-another-orbit-new-threat-iaf-chief/articleshow/89807648.cms?from=mdr

Leveraging Synergies in Industrial & Technology Capabilities for Defence and Space

The fast-evolving geopolitical context combined with the rise of new technologies, demands setting the trend for proactive defence capability building on an immediate basis. A considerable investment in terms of time, money and human resources is required towards development of cutting-edge technology for defence application.

The basic systems necessary for a Space mission include: Propulsion, Structure, Thermal Management, Environmental Control and Life Support Systems (ECLSS), Electrical Power, Avionics, Flight Control System, Communication and Tracking, Vehicle Management (Guidance, Navigation and Control (GN&C) and Mission and Fault Management (M&FM)). The common grounds between these and the defence requirements are easily discernible and are essential to maintain the Defence Force's combat edge. Some of these are explained below:

Communication Systems: The need for integrated platforms to support voice, data, image, multimedia applications and networking is common to both space and defence. This includes the application of digital technology like Software-Defined Radios (SDR). The use of Ka-Band frequencies can provide larger bandwidths, increase total capacity per satellite and result in power and cost reduction of ground stations. Laser communications could be adopted in future to achieve even higher capacity two-way real-time communications with spacecrafts as well as submarines at operational depths. There are several private sector companies who also have strong capabilities in communication systems and in research into photonics, quantum cryptography, optical design and adaptive optics.

Information Dominance and Electronic Warfare (EW): There is a need to exploit the electromagnetic spectrum towards real time information and to safeguard own combat systems, intercept and decipher the adversary's information systems in a time bound manner to serve the need for Wideband SIGINT, COMINT and EW systems. Defence sector reliance on space capabilities calls for augmenting counter space operations.

AI, Cloud Computing and Robotics: This technology is being harnessed by the other Defence Forces as a part of their modernization plans to make communication and data transfer seamless, secure and fast. All the applications used by the Defence Forces can be hosted in the Cloud to deliver new capabilities and timely updates to meet battlefield goals in a secure manner.

Miniaturisation: The space industry's move towards nano-satellites encourages payload and subsystem miniaturisation that also brings benefits to the defence sector in playing a key role towards development of navigation and guidance systems. This should lead to weapons becoming compact and more effective incorporating multiple sensors which work together.

Autonomous Capabilities and Guidance Systems: Space launch segment has mastered a similar level of automation as required for stand-off technology of fire and forget. Defence forces would need to have its own stabilisation and guidance system, now and in future. All the platforms should have an independent, jam proof, reliable and redundant navigation capability.

Adaptive Antenna Constructs: The advanced alternatives of adaptive electronic phase arrays that are required for constantly tracking Low Earth Orbit [LEO] and Medium Earth Orbit [MEO] satellites are equally adept at handling a number of different targets at the same time.

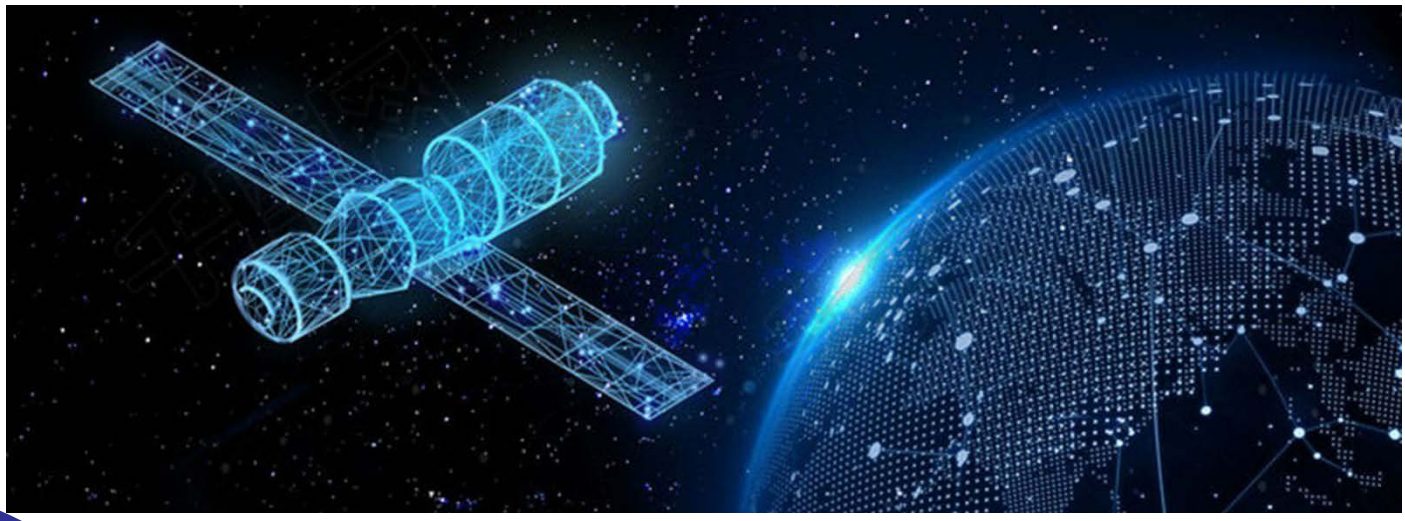
Sensors and Radars: With the advent of digital technology, there needs to be a quantum leap in radar technology. Advanced Digital Signal Processing [DSP] techniques and hardware design have revolutionised radio and radar systems. India has performed commendably in the field of space-borne sensors and the indigenous expertise has potential for exploitation in defence fundamental knowledge in the field of radars, electro-optical and IR sensors, but translation of this knowledge into military systems has not been adequate. Emerging radar technologies such as AESA (Active Electronically Scanned Array) Radar with multi-mode capabilities and Non-Cooperative Target Recognition (NCTR) facility, Synthetic Aperture Radar (SAR) and Inverse SAR (ISAR) capabilities with enhanced processing features and capabilities are going to be trendsetters for future advancements.

Nanotechnology, Composites and Structural Design: The technology acceleration in space has catalysed the need to usher in lightweight, strong, multifunctional advanced materials that may reduce power and weight requirements, increase protection of platforms and durability and thereby enhance operational effectiveness of platforms. Nanotechnology, Carbon composites, metal matrix composites, stealth coatings, self-healing materials etc. have an equally impactful use for the future combat and support systems. The knowledge gained with indigenous development programmes should be utilised for the future projects.

Propulsion Engineering and Fuel Technologies: Fundamental engine technologies such as single crystal blade design, high temperature materials, combustion chamber design and CFD programs should evolve between the short and midterms. Fuel cells and propulsion tech which are also part of space application and could find a number of applications in the defence sector as well from powering unmanned aerial vehicles, ground vehicles and autonomous underwater vehicles etc. This would help meet the high levels of efficiency, reliability, reproducibility, robustness that are the prerequisites for military hardware.

Environmental Ruggedness: Space and defence sector equipment are developed under the same quality of environmental ruggedness. Both sectors require rugged, reliable and safe dependable systems for the harshest and most rugged environments. Their operating requirements and the ability of the various types of electronics systems to meet, survive and perform optimally are the same. The equipment is capital intensive and requires HALT testing for enhancing product reliability. HALT testing is currently used by most manufacturing and research & development organisations to improve product reliability in aerospace, defence and consumer industries globally.

Precision Engineering: The current requirements of precision manufacturing and industrial capability for Space and Defence sectors are similar in nature. In most instances the industry capacities can be utilised to serve both these segments.



Important Market Dynamics of Space and Defence Sectors

Effectively using space capabilities requires a clear and common understanding of space operations and resources and of how they integrate. The Government of India's decision to open the Space domain to private and foreign enterprises is a positive step and opens up several additional avenues to build strategic capacity and capability. The industry is very ambitious to adapt well to this transformation as the space sector activities take full speed. The space sector in India aspires and has the potential of cornering 10-15% of global market share by the year 2030 which translates into the space sector becoming a $50 Bn market.[7]

For India's defence manufacturing sector the Indian Government has set the defence production target at $25 Bn by 2025 (including $5 Bn from exports by 2025) from $11 Bn during 2020-21.[8] These targets are ambitious and need a supporting strategy and approach.

India's Defence and Space manufacturing sector targets are ambitious and need a supporting strategy and approach. The Government has set the defence production target at $25 Bn by 2025 and the Space sector in India aspires to become a $50 Bn market by 2030.

Indian Space Industry is close to $10 Bn industry and employed more than 45,000[9] people. At present it includes over 500[10] private suppliers and other various bodies of the Department of Space in all commercial, research and arbitrary sectors. About 40 active space startups and industries are in consultation with ISRO for support related to development of satellites, launch vehicles, develop applications and provide space-based services.[11] In the case of major satellite missions such as the Mars Orbiter Mission (MoM), over 120 companies have contributed to manufacturing. There is a clear lack of data on the size of India's space manufacturing sector. Roughly the upstream sector that includes the manufacturing of space assets is $2.3 Bn (33%) in 2019-20. [12]

Surge in Space Sector Activities in India

There are thousands of satellites, and satellite constellations launched and planned in this year for commercial and military applications. This calls for developing not just competitive satellite capabilities and applications but also robust counter space capabilities by India. Many nations have already put space labs and have demonstrated the most advanced counter space capabilities.

The Space industry is on the strategic roadmap of taking its rightful place among the established value chain internationally. There have been some very encouraging policy changes that are taking place in the

7 https://telecom.economictimes.indiatimes.com/tele-talk/india-poised-to-become-a-major-satcom-hub-by-2030/5122

8 https://www.livemint.com/news/india/aim-to-achieve-25-bn-in-defence-production-5-bn-exports-by-2025-rajnath-singh-11612515785371.html

9 https://timesofindia.indiatimes.com/india/pm-to-launch-indian-space-association-which-aspires-to-be-the-voice-of-sector-on-monday/articleshow/86896786.cms

10 https://timesofindia.indiatimes.com/india/pm-to-launch-indian-space-association-which-aspires-to-be-the-voice-of-sector-on-monday/articleshow/86896786.cms

11 https://economictimes.indiatimes.com/news/science/nearly-40-proposals-from-private-players-received-by-indias-space-regulator-economic-survey/articleshow/89248281.cms?from=mdr

12 https://www.pwc.in/assets/pdfs/research-insights/2020/preparing-to-scale-new-heights.pdf

The demand in the space sector has been increasing steadily and there is a need for a ten-fold strengthening of the Department of Space to cater to this demand

sector from time to time. However, the space sector needs nurturing similar to the defence sector that needs to be taken care of by timely policy tweaks and implementation.

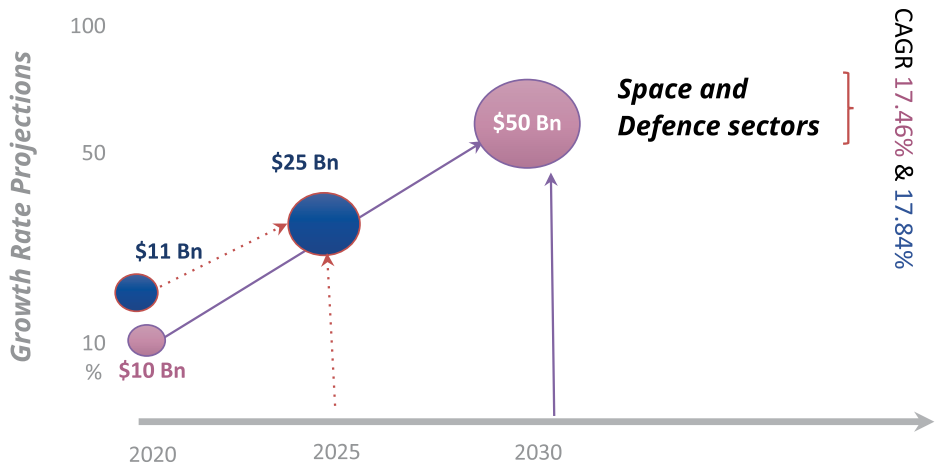
Dr. K Sivan, former ISRO Chief said that the demand in the space sector has been increasing steadily and there is a need for a ten-fold strengthening of the Department of Space to cater to this demand[13] implying a massive potential demand. At the component level, owing to a greater demand for SatCom technology the import component is significant. Around 50 – 55% of components are imported for satellites and launch vehicles at present.[14] In other words, over half of the electronics components on a large satellite and nearly a tenth for a rocket are imported as they need to meet stringent requirements like space heritage.

Some of the Space Manufacturing Trends are:

- 80% of the Polar Satellite Launch Vehicle (PSLV) production is outsourced to private industries.
- More than 80% of space electronics components continue to be imported and carbon composites are sourced.[15]
- The import component is around 10% for launch vehicles and around 50%-55% for satellites.[16]
- The demand for small, lightweight, low-cost satellites and reusable launch vehicles would be the new trend.

India's defence manufacturing sector recorded a production worth $10.9 Bn in FY21, marginal increase from $10.7 Bn in FY20.[17] The government has set the defence production target at $25 Bn by 2025 and targets to export military hardware worth $5 Bn (Rs. 35,000 crore) in the next 5 years. As of 2019, India ranked 19th in the list of top defence exporters in the world by exporting defence products to 42 countries.[18]

Figure1: Projection for Space Sector and Defence Manufacturing Sectors



13 https://www.deccanchronicle.com/science/science/150821/isro-eyes-15-share-in-350-bn-space-economy.html

14 https://www.isro.gov.in/capacity-building/indigenization

15 https://economictimes.indiatimes.com/news/science/indias-lack-of-electronics-manufacturing-ecosystem-is-hurting-isros-space-plans/articleshow/73182823.cms?from=mdr

16 https://www.isro.gov.in/capacity-building/indigenization

17 https://www.ibef.org/download/Defence-Manufacturing-October-2021.pdf

18 https://www.ibef.org/industry/defence-manufacturing.aspx

Some specific measures of last few years bolstering the Defence sector are:

- Streamlining defence procurement.
- Promoting Atmanirbharta in Defence production with Buy (Indian-IDDM) and Buy and Make (Indian) categories of procurement.
- Increased exports.
- Reforming Defence R&D.
- Digital Transformation.
- Defence Testing Infrastructure scheme.
- Enhancing participation of MSME.

There are several companies that are involved in both Space and Defence sectors both viz., Ananth Technologies, Airbus, Mahindra Aerospace, Thales, Tata, Centum, MTAR, Godrej, L&T Defence to name a few. These companies are the leading manufacturers of various space-related products and components serving in the space and defence industry both.

Both Space and Defence industries have an inter dependency on each other and going forward both the sectors will play a complementary role in the upstream and downstream sectors. There is a tremendous opportunity for companies in both the sectors to collaborate with the global companies to work together leading to greater market outreach under offset policy.

Both space and defence industries therefore would have an inter dependency on each other going forward and both the sectors will play a complementary role in the upstream and downstream sectors. The stakeholders will have common goals, the government will have to draft common overarching policy measures so that the sectors grow in tandem and benefit from each other. And one such policy measure would be to include space sectors eligible for defence offsets to boost the indigenous manufacturing and promote exports in both the sectors.

Inclusion of Space Industry under Offset Policy

There is a tremendous opportunity for Space and Defence companies to collaborate with the global companies to work together leading to greater market outreach under offset policy. This would help in establishing long term opportunities and offset partnerships and capitalising the synergies in both defence and space sectors.

The concept of the defence offset has a tremendous capability to give a boost to the Space manufacturing sector in India which has a demand need of 10x. The rampant growth in demand for space sector technology would help meet the offset dues/targets that are partially met through the defence sector presently.

Many major defence players across the globe, have their own business units operating in the Space domain and since these defence players either already have or likely to have offset obligations, it is beneficial for them to cover space along with defence offsets so that their flexibility to meet the offset obligations in India increases. Combining the space offsets with defence offsets can be a welcome move where the OEMs and Indian space and defence industries all set to benefit tremendously. Hence, it will be a shot in the arm for both the space and defence sectors if defence offset rules apply to the Space assets manufacturing sector as well.

It will be a shot in the arm for both the space and defence sectors if defence offset rules apply to the Space assets manufacturing sector as well. Combining the space offsets with defence offsets can be a welcome move and both the OEMs and Indian space & defence industries set to benefit tremendously.

In the US, Defence space partnerships have offered considerable advantages that have allowed the United States to expand and improve its network and capabilities with fewer resources. Similarly, the national Space Strategy of the UK for the first time brings together the country's strengths in Science and Technology, Defence, Regulation and Diplomacy to pursue a bold national vision. Civil and defence activities would have an integrated approach to achieve the Space Targets. The UK is going to have its first Defence Space Portfolio, investing $6.7 Bn over 10 years in the military's satellite communications and $1.9 Bn in new technologies and capabilities.[19]

Japan too launched the Space Operations Squadron (SOS) in May 2020 with a mandate to secure and stabilise space with the expanding cooperation between the Ministry of Defence and the Japan Aerospace Exploration Agency (JAXA).[20]

In India, the space sector targets are quite ambitious and the space manufacturing sector has enormous scope in the value chain. At present, the manufacturing sector consists of 33% of the entire space market and ISRO estimates that in order to meet the rising demand the DoS has to grow by 10-fold. New space policies are being formed to make it commercially feasible for local manufacturers to manufacture the space components as around 40%-50% capacity is outsourced.

Govt. has set a target to transform Indian industry from being a supplier of components to becoming end-to-end designer of space-crafts or launchers. There are massive plans to cut down on imports and boost indigenous manufacturing in the space sector. The formation of Indian National Space Promotion and Authorization Centre (IN-SPACe) to be a Nodal Agency to provide a level playing field for private companies through encouraging policies and a friendly regulatory environment is highly encouraging for the sector.

With the latest reforms and changes in investment rules under the new space policy, it is expected to attract a substantial FDI into the sector in coming years. Such a thrust from the Government of India is intended to create investment opportunities for private companies in the Space sector in India.

The government is looking to reduce the dependence on imported military platforms and has decided to support domestic defence manufacturing. In budget announcements, a total of 68% of the capital procurement budget for defence will be earmarked for the domestic industry in 2022-23, up from 58% in 2021-22.[21] In the space sector too, the Govt. is looking to encourage domestic manufacturing of space assets.

Leveraging the synergies between defence and space industries could help foreign OEMs in discharging their obligations by opening up a new avenue for discharge. This could potentially open up the export market and help India meet the export target of $1 Tn by 2025.

19 https://www.techuk.org/resource/the-uk-s-first-ever-national-space-strategy.html

20 https://www.eastasiaforum.org/2021/01/18/japans-space-defence-policy-charts-its-own-course/

21 https://www.business-standard.com/budget/article/budget-2022-68-capex-for-defence-set-aside-for-domestic-procurement-122020100956_1.html

The Indian Government has announced massive plans on military modernization in the next 5 years. Proactive steps are taken to boost manufacturing of military hardware. According to estimates, the Indian Armed Forces are projected to spend around $130 Bn in capital procurement of defence equipment in the next five years to promote domestic manufacturing.[22] Offsets have definitely helped the sector and the amount of offset discharged has gone up gradually. Till the year 2017, the offset discharge has been very negligible and the percentage of incomplete claims have been extremely high but over the years the ratio has improved with new amendments and rules. Offsets have been constantly amended and revamped from time to time and the Indian defence sector is slowly emerging as an exporter and additionally, the Prime Minister has announced a target of exporting $5 Bn worth of military hardware which is about INR 35,000 crores by 2025.[23]

The qualification of indigenous space capabilities towards discharge of offset obligations can be a game changer. Currently out of the $12 Bn offset obligations, only $5 Bn has been discharged. Leveraging the synergies between defence and space industries could help foreign OEMs in discharging their obligations by opening up a new avenue for discharge. This could potentially open up the export market and help India meet the export target of $1 Tn by 2025.

Further, inclusion of space industry as an avenue of offset discharge will provide additional exposure to the Indian space industry and open up new markets. This can auto enhance the cost competitiveness, so what can start as an offset partner for space, can lead to being a supply-chain partner for the OEMs.

As mentioned, demand for space sector technologies is on the rise. However, in order for the private sector to scale up operations to meet this demand, large capital outlays are required for establishing manufacturing and AIT facilities. Such investments can only be justified if sufficient volumes of order intake are assured. Inclusion of space industry for offset discharge could provide such volumes.

Effective and Transparent Offset Discharge Avenues:

The space and defence sector need a well-articulated and transparent offset policy that can create genuine advantages for the procuring nation. The main objective of India's offset policy is to make the sector self-sufficient and not dependent on imports.

The offset clause is applicable for Buy (Global) categories of procurements where the estimated Acceptance of Necessity (AoN) cost is Rs. 2000 crores (approximately $300 million) or more. 30% of the estimated cost of acquisition in this category will be the required value of the offset obligations.

There are 5 Offset discharge avenues listed in DAP 2020 and with the above context Space sector's products/ goods and services should be listed in the list of products and services eligible for discharge of offset obligations.

Some of the ways through which the offset could be discharged through the space sector in a more meaningful way are illustrated below.

1. **Direct Purchase of Eligible Products & Services:** Under DAP 2020 direct purchase avenue is where the foreign vendor discharges its offset obligations through direct purchase of eligible products and services from Indian Offset Partners. Direct purchase aka export orders is applicable on eligible products manufactured by, or services provided by Indian enterprises, i.e. DPSUs, OFB and private and public sector. The list of products and services eligible for discharge of offset obligations is mentioned at Annexure VI to Appendix-E of DAP 2020.[24] The list however must include the Space

22 https://theprint.in/india/119-capital-procurement-proposals-worth-rs-2-15-lakh-cr-approved-in-3-years-says-govt/698956/

23 https://economictimes.indiatimes.com/news/defence/our-target-is-5-billion-of-defence-export-in-next-five-years-pm-narendra-modi/articleshow/73958737.cms?from=mdr

24 https://www.mod.gov.in/sites/default/files/DAP2030new_0.pdf

sector products and services to make a comprehensive list which will diversify the offset discharge avenues.

The three major sectors of the space industry are: satellite manufacturing, support ground equipment manufacturing and the launch industry. The satellite manufacturing sector is composed of satellites and their subsystems manufacturers. The ground equipment sector is composed of manufacturing items like mobile terminals, gateways, control stations, VSATs, direct broadcast satellite dishes and other specialised equipment. The launch sector is composed of launch services, vehicle manufacturing and subsystem manufacturing et al. Hence, all these space equipment and services from the Indian private industry should be made eligible to meet offset obligations.

2. **Investment in Manufacturing:** This method is where the offset obligation is met either through FDI or direct investment or joint ventures or through the non-equity route for co-production, co-development and production or licensed production of defence products subject to the guidelines/ licensing requirements stipulated by DPIIT/ MHA, Government of India. The list of 'eligible products' is the same as above (Annex VI to Appendix-E DAP 2020). There are several companies that serve both space and defence sectors and hence inclusion of space products and services would not only provide a unique opportunity for the private sector to enter into technology intensive and highly competitive space industry but would also help in expanding the avenues to discharge for the foreign OEMs.

   Again, the list must include the space products and services.

   The Govt. has liberalised the FDI in the space sector upto 100% in satellites-establishment and operation, subject to the sectoral guidelines of the DoS and plans to further liberalise the FDI rules soon. [25] This will highly encourage the MNCs to collaborate with the Indian private industry and subsequently meet the offset targets through this route. This will give an excellent opportunity for 'Start-Ups' and MSMEs which will get a tremendous boost from this initiative.

3. **Investment in Transfer of Technology to Indian Entities:** Offset discharged through technology transfer is the best way than any other modes as technology is perhaps the most crucial of them all from the point of view of development. Inclusion of space sector would open up suitable and much larger avenues for overseas companies to invest in the sectors and to discharge offsets through transferring the required technology to Indian entities for the qualified listed products. This will highly encourage the MNCs to collaborate with the Indian private industry and subsequently meet the offset targets through this route. This will give an excellent opportunity for 'Start-Ups' and MSMEs which will get a tremendous boost from this initiative. Hence, the space sector technologies must also be included in the eligible list of technologies for discharge of offset obligations in Annexure VII to Appendix-E of the DAP 2020.

4. **Technology Acquisition for Government Institutions:** Acquisition of technology through technology transfer to Government institutions and establishments engaged in the manufacture and/or maintenance of eligible products as listed at Annexure VII to Appendix-E of the DAP 2020, should also include space products.

5. **Technology Acquisition by the DRDO:** From the numerous ways in which foreign OEMs can discharge their offset obligations, technology acquisition by the DRDO in areas of critical technology as listed in Annexure-VIII to Appendix-E of the DAP 2020 is also included. The space sector must also be considered in this section to be included in the aforementioned list.

25 https://www.business-standard.com/article/economy-policy/india-to-revise-fdi-policy-for-space-sector-says-isro-chief-sivan-121091301182_1.html

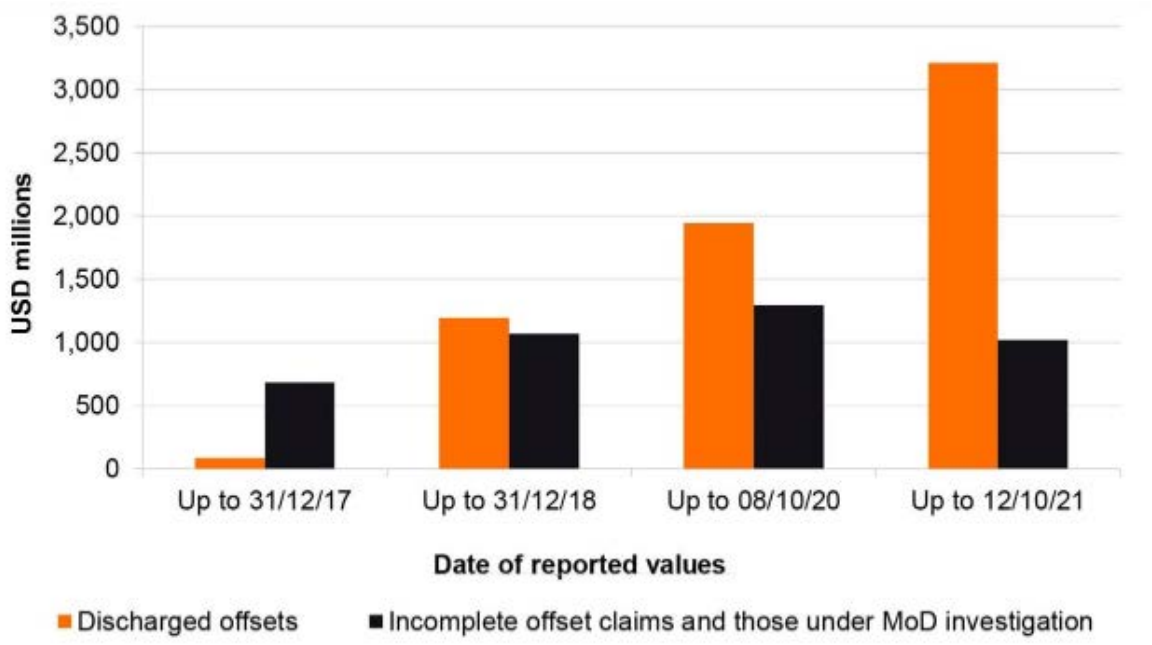
Hence, these are some of the ways in which the space sector along with the defence sector can together meet the offset targets in a more certain and effective way. It will reduce our imports and promote exports. It will help synergistic development of technologies, promote the growth of private domestic manufacturers, including MSMEs and Start-Ups.

Implementation Gaps in the Offset Policy

Discharged defence offsets in India (up until mid-October 2021) were valued at USD3.21 billion. The data provided in the graph shows that between 2005; when India introduced its offset policy, 2007 when the first offset took place – and December 2017, defence offsets worth just $88 Mn had been discharged. However, the value of discharged offsets has been on an increasing trend since 2018-19. In 2020, the discharged offsets increased substantially to $1.19 Bn by the end of October 2020.

Till the year 2017 the offset discharge has been very negligible and the percentage of incomplete claims have been extremely high but over the years the ratio has improved considerably.

Figure 2: Defence Offsets in India



Source: Janes Report Oct 2021

At the end of March 2017, offsets valued at $605.85 Mn were classified by the MoD as "incomplete" or with "clarifications sought". By March 2021 the incomplete claims have already reached $1.3 Bn.

Due to this gap the offset hasn't been as successful and the policy was constantly revamped. The CAG has been critical of the entire policy since the first contract was signed in 2007 until March 2018 as only 59 % of the offsets obligations were met during the period. Further, CAG is not very hopeful of the obligations being met by 2024.

The CAG report 2020 highlighted the lack of high-end technology transfer and negligible amount of FDI made, as means to discharge the offset obligations so far.

More than 90% of offset discharge was undertaken through purchase of products and services and there were very few takers for transfer of technology or FDI as avenues of offset discharge.

As per a study by Institute for Defence Studies and Analyses (IDSA) more than 90% of offset discharge was undertaken through purchase of products and services and there were very few takers for transfer of technology or FDI as avenues of offset discharge. Most of the foreign OEMs prefer MSMEs to ensure the overall cost of offset discharge is minimal but they do not find the right partners for technology transfer by which they can discharge their offset obligations in a cost-effective manner.

Moreover, the defence sector lacks access to modern technology due to a huge defence bill which affects both armament modernisation and maintenance of its military inventory. This is why India's indigenous defence production capability suffers. In order to manufacture indigenously, India needs to invest in cutting edge manufacturing & testing capabilities. The companies need support to effectively operate and test the technologies so that they can produce state-of-the-art defence equipment that are at par with the international standards and not obsolete.

Provision for an Effective Offset - Key Challenges

Clarity on the Discharge Procedures: Foreign OEMs are very keen to supply defence goods to the Indian Government, but the problem of being stuck with an offset obligation which they are unsure how to discharge prevents them from entering the market in the quantum as they would hope.

Discharge Obligations and Responsibilities Need Equal Sharing: The responsibility of discharging the offset obligations falls solely on the foreign OEMs. Even when an Indian Offset Partner (IOP) fails in complying to any provisions, the responsibility falls on the foreign OEMs for which they may be penalised.

Quality Indigenous Manufacturing: The manufacturing companies need the capacity and capability to produce state-of-the-art defence equipment that are best in the global market. Favourable Government policies are required which promote self-reliance, indigenization and technology upgradation aiming at achieving economies of scale, including the development of capabilities, for exports in the defence sector.

In November 2021, the Defence Acquisition Council approved proposals worth INR 7,965 crore ($1 Bn) for Armed Forces modernization under 'Make in India'. And immediately two flight tests of indigenously-developed smart anti-airfield weapons were successfully carried out jointly by DRDO and Indian Air Force.

There needs to be a creation of technology parks or promote a cluster-based approach (similar to automobile industry) where multiple ancillaries grow around major companies in industry hubs, with technology and knowhow flowing between the participants for manufacture, standardisation, quality assurance, facilities exchange etc.

FDI Limits: As stated earlier, the FDI liberalisation will encourage the foreign OEMs – with government approval, they would finally be able to hold a majority stake in any Indian company and not have to depend on an IOP whose decisions were binding on them.

Procedural Time Taken: Any changes to an offset contract or to change the offset partner takes roughly two years to be implemented. Further, if a contract has to go through amendment, it can take an additional one or two years to be approved. As a result, many firms are discouraged from entering India.

Success Stories and Best Practices from other Countries

Several Countries viz., Saudi Arabia, Japan, Brazil and Israel, have already started reaping the benefits of their respective offset policies and have moved ahead of India in leaps and bounds.

Analysing the reasons of success and some of the best practices policies of these countries would help India to adopt necessary changes in its policy framework.

United Arab Emirates: UAE's Offset Program has the most sophisticated criteria than most offset policies. The offset is 60% of the contract value. The offset credit is not evaluated on the investments, but through profit over time of an offset venture.

Saudi Arabia has recognized that they must not only be able to use the technology but also carry it forward before it becomes obsolete. For this reason, their offset programme has progressively stressed the transfer of medium, commercial exploitable technology, rather than 'high' technology, promoting the growth of commercial and dual-use products with wider markets.

Israel has spent large sums promoting research and development (roughly 3% of its GDP) which is at par with the most advanced economies of the world. This, coupled with a highly skilled workforce, has helped Israel to advance its defence sector. Its offset arrangements have resulted in additional investment, new jobs and technology transfer, which the Israeli economy was in a very good position to absorb.

Japan obtained its technology via technology transfer from western countries and subsequently overtook them by constantly striving for self-sufficiency and undertaking licensed production of high-tech military equipment to build up a sizable military industrial complex of its own.

Netherlands: The threshold for offset is € 5 Mn and minimum offset requirement is 100%. Multipliers are between 1 and 5. The focus is on innovation and marketing support and it is directed by the Ministry of Economic Affairs.

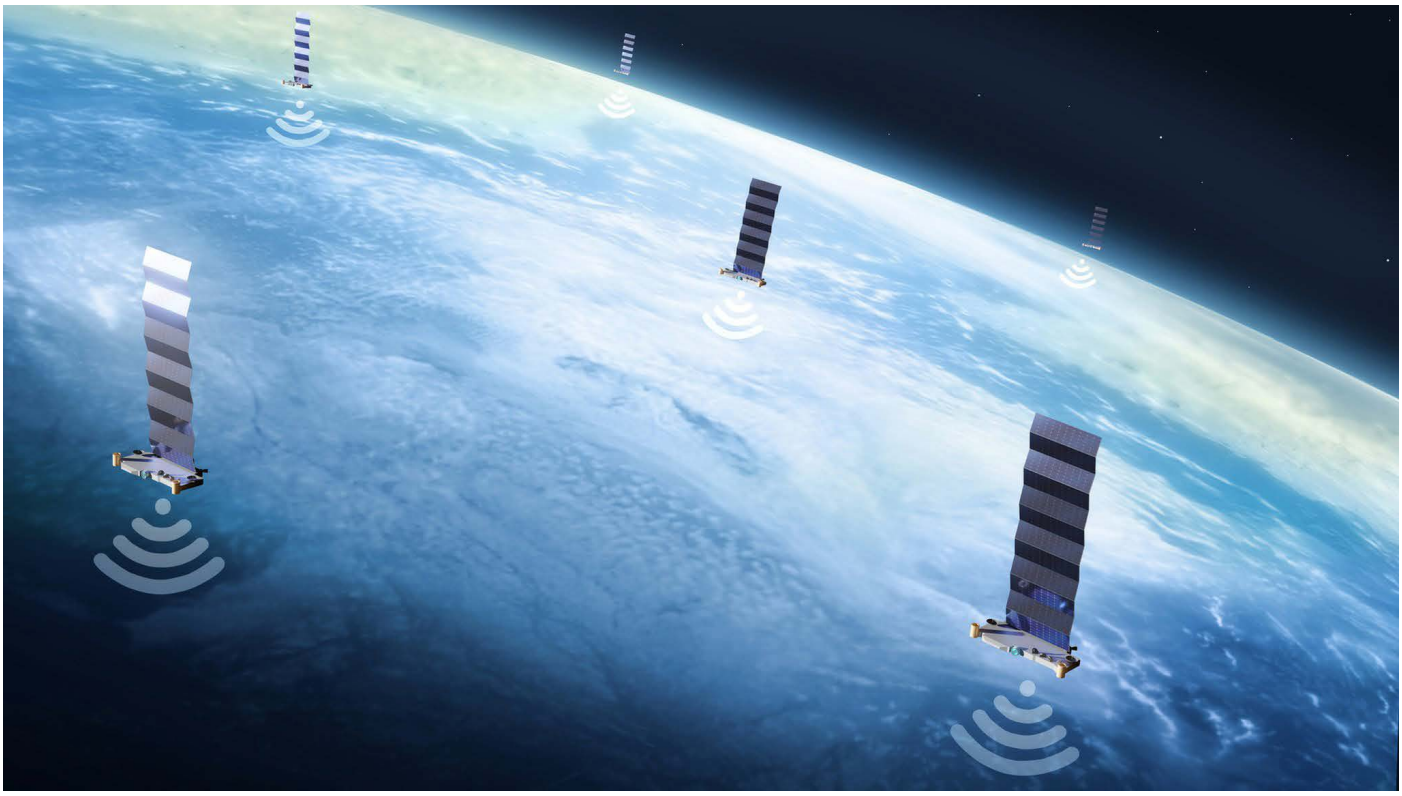
Denmark: The threshold is DKK 50 Mn and offset requirement varies from each project up to 100%. Multipliers up to 8 can be considered for R&D and technology or financial transfers. Denmark signed a trilateral agreement with the UK and the Netherlands on "Best Practice for the Application of Abatements in Offset" regarding swaps of offset obligations.

The success stories from these countries with their offset policy can be implemented and a number of lessons can be learned. Indian companies must look to not just acquire modern technology but to develop a way of retaining and advancing such technology themselves.

Further, the amount spent on R&D needs to be increased so that India can be in touch with other developed countries and not just rely on transferred technology. The budget outlay on space programme has more than doubled in last 10 years, the budget for FY 2022-23 was increased to 13,700 Crore ($1.8 Bn), Rs 833 crore more than FY 2021-22 figures, which was at Rs 13,438 crore.

Without a strong R&D ecosystem, the sector will constantly remain outdated no matter how much technology it receives. Additionally, it must be noted that India ranks very poorly on the Ease of Doing Business and Corruption Perception Index of the world which makes it an unattractive destination for investment (despite projections that it would have the second-highest offsets in the world from 2016- 2021, only behind Saudi Arabia).

Steps must be taken to ensure complete transparency in operations involving offsets as well as a more convenient way in which foreign OEMs can carry out their business.



Summary of Recommendations

Defence procurement in India needs to adopt a mix of procurement avenues in which the indigenous solutions, foreign equipment and futuristic R&D continue together and a healthy balance is struck between them. It is important to incentivise the indigenous procurement and encourage futuristic R&D while continuing to fill the critical voids with foreign equipment. While this is already happening, there is a need to start planning for the next cycle of procurement today which may start in the next 5 to 10 years.[26]

A key measure that could be a game-changer for the defence and space sectors is inclusion of the space sector in the discharge of defence offset obligations. The Space sector being the 'Fourth Frontier' of Defence, the inclusion of space sector in discharge of offset obligations could be a major catalyst for both the sectors. Sourcing of space equipment and services- including sounding rockets, components, subsystems etc., from the Indian private industry and launch services of foreign satellites through ISRO's PSLV/GSLV, should be made eligible to meet offset obligations.

- Such a measure will leverage the synergies between defence and space industries.
- It could help foreign OEMs in discharging their obligations by opening up new avenues for discharge.
- Offset targets could be met efficiently making the defence sector self-sufficient and not dependent on imports heavily.
- This measure could also potentially open up the export market and help India meet the export target of $1 Tn by 2025.
- Inclusion of the space industry as an avenue of offset discharge will provide additional exposure to the Indian space industry and open up new markets. This can auto enhance the cost competitiveness, so what can start as an offset partner for space, can lead to being a supply-chain partner for the OEMs.

26 https://www.idsa.in/idsacomments/defence-procurement-in-india-mrana-021221

Annexure 1

Brief Background on Offset Policy

Offset Policy has always been a key tool used in the defence sector, through which, an original equipment manufacturer (OEM) is obligated to invest a certain percentage of the contract (upwards of 30%) into India towards exports, R&D, Technology Transfer, JVs or manufacturing. This is a common norm world over where the importing country leverages their buying power by making the exporting country discharge offset obligations.

The offset policy in India was initiated in the year 2005 with a view towards making the foreign OEMs participate in the Indian defence sector. Since defence contracts are expensive, the policy intends a part of the money spent on buying to either benefit the Indian industry, or to allow the country to gain in terms of technology.

The policy on offsets was first introduced as part of Defence Procurement Procedure ('DPP 2005') on the recommendations of the Sixth Standing Committee on Defence and over the years it has gone through several changes to incorporate various demands and changes in the economy.

The first offset contract was signed two years later in 2007.

The objective for defence offsets are:

(i) *Fostering development of internationally competitive enterprises,*

(ii) *Augmenting capacity for Research, Design and Development related to defence products and services and*

(iii) *Encouraging development of synergistic sectors like civil aerospace, and internal security.*

Offset Policy Amendments over the Time

Defence Procurement Procedure (DPP), 2016

In 2016, MoD released the revised defence procurement policy which set the tone to boost the 'Make in India' initiative in the defence sector and to speed up the procurement process. It gave priority to procurements of indigenously designed and developed products over imports.

DPP-2016 raised the offset threshold limit to Rs 2,000 crore (approximately $300 Mn) from Rs 300 crore meaning only those foreign OEMs which win deals worth over Rs 2,000 Crore will have to plough back at least 30% of the deal value into Indian enterprises as offsets. Deals with contract values of less than Rs 2,000 Crore will be exempted from the offset obligation.

While the large quantum of offsets discharged through purchase of products and services augurs well for India's export ambitions, in reality, these relate to small parts & components export and not to any achievement of actual sophistication. And this is due to lack of technological sophistication and their poor performance during trials.

Defence Acquisition Procedure-2020 (DAP-2020)

To fix these concerns, the Defence Acquisition Procedure-2020 (DAP-2020) has been issued with substantial changes introduced in the policy framework with effect from October 1, 2020. DAP 2020 aims to strengthen the existing offset related provisions and proposes higher multipliers for offsets discharged through FDI and technology transfer.

A much-improved rationalisation of offset policy took place with DAP 2020. It was expected that the offset policy under the DAP 2020 would bring in much-needed changes in guidelines. DAP 2020 is to administer contracts with an aggregate value close to $60-70 Bn of capital procurement with a workable offset procedure.

Table: Key Features of Offset Guidelines 2020

Offset Discharge Avenue	IOP	Offset Discharge Subject To	Multiplier
Direct purchase of eligible defence products & Services	Both private and public sector including DPSUs / OFB	List of eligible defence products in seven categories (civil infrastructure generally excluded)	0.5 for components of eligible product; 1.0 for eligible products; 1.5 if IOP is Micro Small and Medium Enterprise (MSME)
Investment for manufacture of eligible defence products*	Private sector / DPSUs / OFB	List of eligible defence products in seven categories (civil infrastructure generally excluded); No restriction on production, sale or export	2.0 if investment is in notified Defence Industrial corridors; 1.5 in other places
Transfer of technology for manufacture of eligible products	Private sector / DPSUs / OFB	List of eligible defence products in seven categories (civil infrastructure generally excluded).	2.0
Technology acquisition for government institutions*	DRDO / DPSUs / OFB, etc.	Identified list of technologies in 49 areas	3.0
Technology acquisition*	DRDO	List of critical technologies in 32 areas	4.0

Key Policy Changes in the DAP 2020 Related to Offset

- The new revamped offset rules would not be applied to Government-to-Government agreements (G2G), ab initio single vendor contracts or Intergovernmental Agreements (IGA).
- It proposes higher multipliers for offsets discharged through FDI and technology transfer.
- Multipliers have also been used to incentivise purchase of complete defence equipment instead of parts & components.
- Instead, the Government has increased focus on choosing procurement avenues that require at least a certain percentage of the total order to be indigenously produced. The indigenously produced component is referred to as '*indigenous content*' (IC) in a product and is arrived at by reducing the value of imported components and fees/royalties paid in foreign exchange from the basic cost of the equipment.
- The DAP-2020 now specifies higher IC requirements for various procurement categories, as compared to previous iterations.
- The minimum IC stipulated by the DAP-2020 is 50%, and therefore, at least some sophisticated manufacturing will have to be transferred to India.
- With the Government increasing the automatic route FDI limit in the A&D sector to 74%, it is expected that OEMs should now feel comfortable transferring sophisticated technologies to their subsidiaries in India.

In introducing these changes in DAP2020, the Government has signalled that going forward; manufacturing in India is the only option. The Government has paved the way for foreign OEMs to show that they are dedicated to the '*Make-in-India*' initiative and that to be able to continue to actively participate in Indian defence sales, OEMs will have to become partners in India's growth story.

Annexure 2

LIST OF PRODUCTS ELIGIBLE FOR DISCHARGE OF OFFSET OBLIGATIONS

Annexure VI to Appendix E (Reproduced from DEFENCE ACQUISITION PROCEDURE 2020)

(Refer to Paragraph 2.2.1 and 3.1(a), (b) and (c) of Appendix E)

1. **Arms**. Small arms, mortars, cannons, guns, howitzers, anti-tank weapons.
2. **Ammunition and Explosives**.
(a) Bombs, torpedoes, rockets, missiles.
(b) Energetic materials, explosives, propellants and pyrotechnics.
3. **Armoured Vehicles**.
Tracked and wheeled armoured vehicles, vehicles with ballistic protection designed for military applications, Mine protected vehicles.
4. **Naval Platforms**.
(a) Vessels of war and special naval systems.
(b) Weapons, sensors, armaments, propulsion systems, machinery control systems, navigation equipment/instruments, hull forms of warships, submarines, auxiliaries related to Paragraph 4(a) above.
(c) Other Vessels/crafts/boats related to Paragraph 4(a) above.
5. **Aircraft**.
(a) Aircraft including helicopter, unmanned airborne vehicles, aero engines for military use.
(b) Maintenance, Repair and Overhaul (MRO) related to aircrafts and helicopters.
6. **Electronics and Communication equipment**. Electronics and communication equipment specially designed for military use such as electronic counter measure and countermeasure equipment surveillance and monitoring, data processing and signaling, guidance and navigation equipment, imaging equipment and night vision devices, sensors.
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7. **Other Defence Products**.
(a) Forgings, castings and other unfinished products which are specially designed for products for military applications.
(b) Personal Protective Equipment.
(c) Troop Comfort Equipment.
(d) Parachutes.
(e) Direct energy weapon systems, counter-measure equipment, super conductive equipment.

Note:

(i) Components related to above categories are also eligible for offset discharge.
(ii) Investment in civil infrastructure and related equipment is excluded from the list of eligible products and services, unless specifically indicated.

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Annexure 3

LIST OF TECHNOLOGY ELIGIBLE FOR DISCHARGE OF OFFSET OBLIGATIONS

(To be reviewed periodically)

Annexure VII to Appendix E (Reproduced from DEFENCE ACQUISITION PROCEDURE 2020)
(Refer to Paragraph 3.1(d) of Appendix E)

i. 250 KW Silver Zinc Battery
ii. Guidance wire for Torpedo
iii. Helicopter Fire Control System
iv. Mine Counter Measure Vessel
v. Early Warning Suite for fighter aircraft
vi. Diesel engine technology for ships
vii. Powder Metallurgy Technology (for 3D printing – TI Alloys, Tungsten Alloy and Super Alloy)
viii. Single crystal/Dissolved crystal
ix. Magnetic signature duplicator (MSD) or Electro-magnetic device (EMD) for use in conjunction with mine plough attachments for main battle tank.
x. Light weight armoured composite material and fabrication/manufacturing
technology.
xi. Engine for Futuristic Infantry Combat Vehicle.
xii. Marine Gas turbine for warship propulsion
xiii. Propeller and Shafting
xiv. Magazine Fire Fighting System
xv. Propulsion Motor Technology
xvi. Cognitive Computing
xvii. Waveforms for Cognitive Radios
xviii. WIFI Technology for Smart Next Generation Radios
xix. Advance OFDM Waveform with MANET features
xx. RAS equipment's & NATO Probes
xxi. Machine Learning
xxii. Cyber Technologies
xxiii. AESA Radar
xxiv. Optics
xxv. RLG Sensors
xxvi. Flight Control Servers
xxvii. HUMS- sensors technology, integration, data storage and analysis
xxviii. Smart MFDs Algorithms, open system architecture
xxix. Large Area Displays with touch screens- display, data handling
xxx. Electro-Optic Sensors technology and integration
xxxi. Infra-Red Sight and Target sensors technology and integration 129

xxxii. Encryption Techniques for Video/ Audio/ Digital Data in Variable Frequency Bands
xxxiii. Encryption Techniques for Secured Data Links
xxxiv. Digital Flying Controls computational techniques
xxxv. Automatic Flying Controls Systems and sensors—Design Process
xxxvi. Light weight rugged ship borne radar antenna design technology
xxxvii. Intermediated Frequency Stage Video Extractor for Radar.
xxxviii. Light weight Base Line Interferometry (BLI) and Circular Interferometry (CI) wide band ESM antenna
xxxix. Active sonar system with multi-static capability
xl. Flex-tensional low frequency transducer.
xli. Micro Electro Mechanical System (MEMS) elements and fiber optic sensor based underwater transducer
xlii. Acoustic sensor with passive Target Motion analysis (TMA) capabilities
xliii. Mine and Obstacle avoidance Tools
xliv. Artificial Intelligence Enabled Systems Technology
xlv. MPMSDF/TERA
xlvi. Unmanned Under Water Vehicles (UUVs)
xlvii. Al Enabled Automatic Test Equipment
xlviii. Air Independent Propulsion (AIP) like Fuel Cells and Sterling Engine System for marine application
xlix. Non-Hull penetrating Masts for submarines.
l. Li-Ion Batteries for submarines
li. Radar absorbent paints for submarine and masts
lii. Multi-phased generators and special rectifiers
liii. Specialized cables associated with weapons and sensors.

Note: *(i) All items above will be restricted to defence sectors only.*
(ii) Investment in civil infrastructure is excluded unless specifically indicated.

Annexure 4

LIST OF CRITICAL DEFENCE TECHNOLOGY AREAS AND TEST FACILITIES FOR ACQUISITION BY DRDO THROUGH OFFSETS

(To be reviewed periodically)

Critical Technology Areas*

Annexure VIII to Appendix-E (Refer Para 3.1(e) of Appendix-E)

(i) Seeker Technology
(ii) Jet engine above 90KN
(iii) Technology Modules for High Performance Drones
(iv) MMIC for usage in high performance RF Design for Radios
(v) Robotics for smart Ammunition
(vi) Balance life assessment technology/Medium Refit Life Certification
(vii) Graphite Block with high flexural strength for application in nozzles for rockets.
(viii) Smart Ammunition including precision guided ammunition, course correction fuses.
(ix) Fiber Optics data bus(CANBUS/ARINC 818 /AFDX), Data Bus cards and associated accessories
(x) Single Crystal Blade Manufacturing Process
(xi) Stealth Technology
(xii) Variable Exhaust Nozzle actuation mechanisms for straight and Vectored Thrust application
(xiii) Sensors, actuators, RF devices, Focal plane arrays.
(xiv) Nano technology based sensors and displays.
(xv) EM Rail Gun technology.
(xvi) High efficiency flexible Solar Cells technology.
(xvii) Molecularly Imprinted Polymers.
(xviii) Technologies for Hypersonic flights (Propulsion, Aerodynamics and Structures).
(xix) Technologies for generating High Power Lasers and CW Fiber Lasers.
(xx) Pulse power network technologies.
(xxi) Tera Hertz Technologies.
(xxii) Surface Coated Double Base (SCDB) Propellant
(xxiii) Shock Hardened Sensors
(xxiv) Shared Aperture Antenna
(xxv) Space Time Adaptive Processing (STAP) methodologies
(xxvi) Optical TRMM's/optical to RF units
(xxvii) Aramid Fiber & High Performance Polyethylene Fiber Production Technology.
(xxviii) Manufacturing of 1,2,4-Butanetriol by Microbial synthesis (Biotechnology)
(xxix) Super Capacitors
(xxx) Tactical sensors for detecting biological agents.
(xxxi) Artificial Intelligence based under water target detection.
(xxxii) Extended Range Guided Munition (ERGM) projectiles for larger caliber guns.

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Glossary of Acronyms and Abbreviations

AoN	Acceptance of Necessity
AESA	Active Electronically Scanned Array
Bn	Billion
CAG	Comptroller and Auditor General of India
CAGR	Compound Annual Growth Rate
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance.
CFD	Computational Fluid Dynamics
COMINT	Communications Intelligence
DAP	Defence Acquisition Procedure
DGDE	Directorate General Defence Estates
DOS	Department of Space
DPIIT	Department for Promotion of Industry and Internal Trade
DRDO	Defence Research and Development Organisation
DPP	Defence Procurement Procedure
DPSU	Defence Public Sector Undertakings
DSA	Defence Space Agency
DSP	Digital Signal Processing
DSRA	Defence Space Research Agency
ECLSS	Environmental Control and Life Support Systems
ELINT	Electronic Intelligence
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GIS	Geographic Information System
GN&C	Guidance, Navigation and Control
GSLV	Geosynchronous Satellite Launch Vehicle
HALT	Highly Accelerated Life Test
ISRO	Indian Space Research Organisation
IDES	Indian Defence Estates Services
IC	Indigenous Content
IGA	Intergovernmental Agreements
IN-SPACe	Indian National Space Promotion and Authorization Centre
IDSA	Institute for Defence Studies and Analyses
IOP	Indian Offset Partner
ISR	Intelligence, surveillance, target acquisition, and reconnaissance
MoM	Mars Orbiter Mission
MHA	Ministry of Home Affairs
MSME	Micro, Small and Medium Enterprises
M&FM	Mission and Fault Management
NCTR	Non-Cooperative Target Recognition
NLOS	Non-line-of-sight propagation
OEM	Original Equipment Manufacturer
OFB	Ordnance Factory Board
PSLV	Polar Satellite Launch Vehicle
PNT	Positioning, Navigation and Timing
R&D	Research and Development
VSAT	Very-Small-Aperture Terminal
SIGINT	Signals Intelligence

About SIA-India

SatCom Industry Association (SIA-India) is a not-for-profit body created to represent the interests of the satellite communication ecosystem in India.

As a vibrant body, SIA-India represents satellite operators, satellite systems, launch vehicles, ground and terminal equipment manufacturers and suppliers, satellite-based IOT/M2M solution providers, space startups, innovation hubs, academic institutions, law firms and provides interface with Government, Regulators, Policymakers, and domestic & international standards' bodies.

As 'Thought Leaders' for the satellite communications ecosystem, we aim to present the industry's interest at the highest Government levels for policy-making, regulatory and licensing matters.

SIAINDIA
SatCom Industry Association

For more information, please contact

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