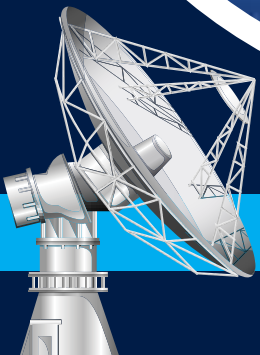


Industrialisation of India's Space Capabilities: Symposium and Roundtable



A Joint Initiative by NIAS and SIA-India

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Preamble

In recent years, there has been significant growth in the space economy, driven by a combination of government and private investments, technological advancements, and increased commercial opportunities. Governments have invested in space exploration, resulting in the development of new spacecraft, satellites, and other technologies, as well as deeper research in space science. Private sector investment has resulted in the development of operational space systems, such as new launch vehicles, reusable rockets, and technologies related to space travel, at affordable costs. Advancements in satellite technologies have made them smaller, lighter, and more efficient, opening up new commercial opportunities in areas such as telecommunication, earth observation, and remote sensing. Commercial space tourism has attracted significant investment, with several companies developing related technologies to make short-duration space travel a routine tourist attraction. International collaborations are also an important component of these developments, with countries and organizations working together on space projects and sharing resources and expertise.

For a nation that is already involved in space exploration and aspires to capture a significant share of the global space economy, it is necessary to expand its industry ecosystem with a well-defined scope, enhanced capabilities, roles, and activities to achieve national goals. This requires investment from both government and private sectors in space-related research and development, infrastructure such as launch facilities, satellite communication networks, mission control centres, applications, and services. Collaboration between academia, industry, and the government is also necessary to accelerate the development of new space technologies and applications, drive innovation, lower costs, and accelerate the development of newer technologies. The government should encourage the private sector with tax incentives, regulatory and other forms of support, and invest in space-related education and training to develop a skilled workforce capable of supporting the country's space industry and program at large.

**NIAS-SIA-India Joint Event on:
Industrialization of India's
Space Capabilities:
Symposium and Roundtable**



Considering recent developments in the space industry and the aim to industrialize India's space capabilities, NIAS and SIA-India jointly hosted a symposium and roundtable discussion. The purpose of this event was to identify key issues involved in industrializing the country's space capabilities and to propose feasible policy initiatives and actions that will enable India to play a significant role in the national and global space arena.

The event brought together national stakeholders from the space industry ecosystem, space policymakers, diplomats, executives, lawyers, financiers, military leaders, academics, innovators, and industrialists [List of participants can be accessed in Annexure-1]. The event was organized in two sessions, with a focus on discussing national and global space strategy contours, emerging commercial opportunities and challenges, structural fault lines inhibiting growth, and key enablers such as policy interventions, procurement mechanisms, and civil-military fusion for catalysing growth and innovation.

The first part of the event was conducted as a seminar with four keynote speakers addressing the gathering. They highlighted aspects related to awareness creation and implementing space reforms that are industry-friendly, and distinguish the industry working for the Indian Space Research Organization (ISRO) from other players.

The second part, a roundtable discussion, that solicited free and frank views, opinions, and comments from the participants, was held under Chatham House Rules. The deliberations held during the roundtable have been collated into an 'outcome document'

by SIA-India. This document will be shared with relevant ministries and decision-makers to provide necessary directions to foster the growth of the country's space sector industry.

The event is also a prelude to the upcoming SIA-India conferences during the year, namely, DefSAT 2023 and India Space Congress 2023.

DefSat-2023 will take place from the 27th to the 29th of April 2023 at the Manekshaw Centre, New Delhi, bringing together experts and stakeholders from the defence and space sectors to discuss the opportunities and challenges of leveraging space technology for defence purposes.

The 2nd edition of the India Space Congress, with the theme "Reimagining Space for Socio-Economic Development," will take place from 12-14 July 2023. The conference and exposition will provide a platform for industry leaders, policymakers, researchers, and academics to discuss ways to accelerate the growth and progress in India's space sector.

The outcome of the symposium and roundtable discussion on 'Industrialisation of India's Space capabilities', A Joint Initiative of



NIAS and SIA-India, will be further discussed at these conferences.

HIGHLIGHTS OF SESSION-1

Introductory Remarks and Keynote Addresses:

The introductory session highlighted that while India's space industry has made significant progress, it still faces challenges such as regulatory bottlenecks, limited transparency, and difficulties in accessing funds and new markets. However, the introduction of new policies like the Geospatial Guidelines, National Geospatial Data Policy, upcoming Space Policy, and Draft Space Bill, as well as the establishment of the Indian National Space Promotion and Authorization Centre (IN-SPACE), is expected to enable greater private sector participation and help unlock

the full potential of India's private space sector.

Dr Subba Rao Pavuluri, President of SIA-India & CMD of Ananth Technologies Ltd, emphasized the need for India to engage in dialogue with other nations on how to support the development of less developed countries in the space and defence sectors. He also stressed the potential advantages that India can leverage from the G20, including military and civilian integration and the creation of new defence applications utilizing space technology.

Dr Shailesh Nayak, Director of the National Institute of Advanced Studies (NIAS), stressed the need for India to take a strategic approach to its space industry, starting with demand assessment to determine the number and kind of satellites that will be needed in the future.

This is crucial in making investment decisions and securing global contracts. Without a clear understanding of the demand for satellite services, investments in the sector may not be forthcoming.

Dr Nayak emphasized the usefulness of collaborating with the SIA-India to analyse the changes that have occurred in the Indian space industry. During his remarks, Dr Shailesh Naik highlighted that the Indian space industry has undergone significant changes in recent years. He specifically noted that in the past, the industry was primarily focused on supporting ISRO. In more recent times, Indian space companies have begun to undertake the activities on an end-to-end basis, commercially; and are keen on taking active roles in the global arena as well.

The event featured keynote addresses by Fmr. Ambassador Rakesh Sood, a foreign policy and strategic affairs expert; Lt Gen PJS Pannu (Retd.), former Deputy Chief of the Indian Integrated Defence Staff - Operations; Advocate Ashok GV, Managing Partner of Factum Law; and Mr Laxmesh Hasanabadi, Vice President & Head of Missiles and Aerospace Business at L&T (Defence). They discussed issues related to space diplomacy, defence/national security, and legal/regulatory matters.

The speakers emphasized the need to assess the demand and potential of India's space sector and stressed the importance of private industry's ownership of intellectual property (IP) and cross-sectoral collaboration. They noted that the second space age is distinct from the first, with 90% of all space launchers in 2020 operated by the private sector. The discussions also highlighted the importance of close collaboration with other countries.

The speakers stressed that strategic communication and intelligence are critical for military success and that creating demand is crucial for unlocking the potential of the downstream market in space. They further emphasized the importance of investing in data centres and decision-making at the edge for success.



Positioning India's Space Commerce in the era of Global supply chains amid the Geopolitical Flux

Keynote Address by Ambassador Rakesh Sood, former Indian Diplomat and a prominent expert on international security and disarmament.



One of the biggest hurdles that India faces is the geopolitical flux that characterizes the global order today. Rising tensions between major powers such as the United States, China, and Russia could impact the development of international norms and regulations that govern space commerce. This, in turn, could affect India's ability to leverage its space capabilities for economic and strategic purposes.

Moreover, India's space industry is still in its infancy compared to that of its peers. It lacks the scale and resources that countries like the United States, China, and Russia can bring to the table. This makes it even more important for India to focus on building partnerships and collaborating with other countries to develop a thriving space industry.

To overcome these challenges, India must focus on enhancing its capabilities in space technology, research and development, and innovation. It must also develop a clear strategy to position itself as a leader in the emerging field of space commerce and work towards creating a conducive environment for the growth of its space industry.

Ambassador Rakesh Sood highlighted that the world is in the second Space Age, which had begun with Sputnik. During the Cold War, the primary applications of the Space Age were on the military front, and the US and USSR dominated space activities. India started engaging in space roughly in 1967 and imported the structure of the Department of Atomic Energy to set up the Space Commission and ISRO in 1969. During the first Space Age, India did well, being led by pioneers, but the government continues to be in the lead, catching up with the new era.

By 2020, 90% of the launches were by the private sector, a significant shift from the first Space Age. SpaceX had 62 launches in 2022, and ESA had six launches in 2022. Starlink has about 3,000 satellite constellations, and ESA has about 50. Today, India has about a hundred space startups, and defence has been separated from mainstream space activities.

ISRO got caught up with the Cold War politics when India's guided missile capabilities got stuck with the MTCR and the sanctions on the industry. It is essential to decentralize the role of ISRO and the role it is best suited to play in the space sector. A legal framework in play in the country would help the industry take shape in the country, and it is also important to decentralize the role of ISRO in the space sector. A legal precedent and some decentralizations are required. Defence research has been given importance too, and DSA came to being an extension of the integrated cell with many labs under its leadership. Institutions like SIA-India, New Space India Limited, INSPACe, and new sectors are emerging in the country. In 2017, a Space Bill was introduced that fell apart in 2019, and a new bill is being talked about now.

Amb Sood said, "Policy is just a guide only, a law can enable the guideline". Ambassador



Sood's statement highlights the importance of laws as the foundation for effective governance, particularly in space policy. While policies can guide how to implement or enforce laws, they are not legal bindings in the same way as laws.

Ambassador Sood is implying that policies cannot have true legal authority and legitimacy unless they are grounded in laws that are recognized and established by the Constitution. He references Article 77, Section 3 of the Constitution and the concepts of "de facto" and "de jure" to emphasize the importance of having laws as the foundation for policies. While policies may have de facto authority or influence, they cannot replace or supersede the legal authority of laws, which exist de jure. Therefore, it is essential to establish laws that govern a particular area or issue before developing policies to support or implement those laws, so that the policies have a solid legal foundation and are recognized as legitimate de jure.

Furthermore, the Indian startups that are awaiting their opportunity to display their capabilities are well placed to take up the mantle of the Indian industry, and its engagement with other countries. A strong track record is needed to engage with other countries. Guidance on these aspects would be useful to take the space industry on the right path.

During the Q&A session, the potential for collaboration between India and Australia was discussed, but it was noted that India's alliance with the US may limit its options. To enhance its capabilities in satellite fabrication and launch, India could explore opportunities to build its supply chains or collaborate with other countries through contract or

subcontract-based arrangements. The success of China in regions such as Africa, Latin America, and Oceania was also discussed, and there may be lessons for India to learn from their model. Despite China's ten-year lead, India should prioritize quality assurance, manpower development, and licensing to ensure sustainable growth.

In Short Amb Sood emphasized the growing need for global cooperation and partnership to address the various challenges facing the world today. He stressed the importance of understanding each other's perspectives and the need for empathy and respect to foster better relationships between nations. He also highlighted the role of technology and innovation in advancing sustainable development and improving people's lives.

Additionally, he underscored the need for effective governance and leadership to ensure that policies and strategies are implemented efficiently and effectively.

In conclusion, India has the potential to emerge as a key player in the global space industry. However, it must navigate the challenges posed by the geopolitical flux and the competitive landscape of the global space economy. By focusing on innovation, collaboration, and strategic planning, India can position itself to reap the benefits of the rapidly growing space industry in the years to come.

Overall, Ambassador Sood's message seems to be one of optimism and hope, but also a call of action for leaders to work together towards a more prosperous and peaceful future.



Preparing a Civil-Military Integration Catapult for Space Sector Industrialization

Keynote Address by Lt Gen PJS Pannu (Retd.), PVSM, AVSM, VSM(Retd) Fmr. Deputy Chief, Integrated Defence Staff (Operations) and Chair of the Aerospace and Defence Committee at SIA-India



Lt Gen Pannu highlighted the importance of civil-military integration in the space sector for industrialization and discussed ways to prepare for it.

Intelligence plays a crucial role in times of war, and strategic communications have historically been provided by aircraft and other traditional means. However, India has missed out on the first space age, relying on foreign embassies and traditional human intelligence methods

for information. As tensions with neighbouring countries persist, India needs to establish its defence space capabilities to gather accurate and timely intelligence.

The military's needs for technology and information are often not fully understood by the industry, which can hinder the development of advanced capabilities. To meet the military's needs, the industry must focus on providing modified civilian capabilities, such as more focused and detailed ISR data. India must also use technology to build smart frontiers that provide a common operating picture and cover key land and sea locations.

In addition to accuracy and speed, secure communication is of utmost importance in military data. The use of cyber, AI, and ML with secure communication, PNT, and ELINT can aid in the development of an Internet of Military Things and an Internet of Battle Things.

Lt Gen Pannu's speech touches upon several key aspects of strategic communication and intelligence. One of the key points he mentions is the importance of communication in providing information to allies such as the Americans and the British. He notes that data is collected and converted into warnings, but ambiguity in information can lead to major intelligence failures.

He goes on to discuss the significance of the 2nd space age and how it has resulted in the development of the DRDO, DSA, ISPA, and SIA-India. He also highlights the importance of spatial intelligence in understanding Chinese deployment and the build-up of their defence capabilities. He emphasizes the need for precision and low latency in communication, and the importance of surveillance and

reconnaissance capability in the development of an Intelligence Plan for the battlefield.

The Lt Gen further highlights the mismatch between what the military needs and what the industry can provide, leading to issues in indigenous production. Indigenization is essential for long-term security, and industry must be supported to develop niche and cutting-edge technology to meet military needs. A philosophy and doctrine to explain military needs to industry would aid in this process. In the end, India must strive for global standards in military technology to ensure the best possible capabilities for its military.

He suggests that R&D is a long and challenging process to leverage indigenization, and TOT is inferior. He also points out that soldiers are strong up to a point, beyond which they need to be capacitated with powerful technology, and the economics of fighting a war is also essential.

Finally, Lt Gen Pannu mentions the need to build and support Industry 4.0 to reach 5.0 and to go by global standards to be the best in the world. He suggests that data will be equivalent to terabytes multiplied by X per second and that it is critical to aggregate unused data for India's use under space diplomacy. Overall, the speech emphasizes the importance of technology and intelligence in modern warfare and the need for India to be at the forefront of these advancements.

In conclusion, Gen. Pannu emphasized the need for India to build cutting-edge technology and establish global standards to aid its military and power its economy. By leveraging technology and space diplomacy, India can establish a common operating picture and build niche capabilities that meet its military needs.

A large satellite dish antenna is the central focus, set against a dramatic sky transitioning from a deep blue at the top to a bright orange and yellow at the bottom, suggesting a sunset or sunrise. The dish's structure, including its ribs and mesh surface, is clearly visible. In the foreground, other smaller antennas and support structures are partially visible, adding depth to the scene.

Structural Fault Lines that Inhibit Private Sector Growth in the Space Industry

Keynote Address by Mr Ashok GV, Partner,
Factum Law

In the discussion, Advocate Ashok GV highlights several issues related to the development and regulation of the space industry in India. It notes that historically, space activities were seen as political and state-driven, but there is now increasing involvement of the private sector. However, several challenges inhibit the growth of the private sector in this area.

India's ability to address geopolitical challenges is also a concern. In the past, India has relied on external inputs for high-resolution images leading to bureaucratic challenges and uncertainty.

One issue is the convergence of commercial, political, and state activities, which requires a holistic policy approach. Additionally, there are security concerns, such as India's dependence on foreign vendors during the Kargil conflict, and regulatory challenges, such as the need to clarify the roles of different agencies like DoT and DoS. The Space Activities Bill, for example, does not address the body responsible for investigating the contamination of space. Commerce and trade are crucial factors in policymaking, and current regulations tend to over-regulate without adequately addressing crucial management questions.

There is also a fear of what can go wrong, such as the criminalization of contamination in space, and the need for adequate law enforcement to investigate such incidents. The discussion suggested that a clear and predictable space policy is needed, which reflects convergence and meets ideal investor regulation, diversity, and economic, trade, and geopolitical trends.

The discussion also emphasized the need for independent policymaking and leadership in

India's space program, rather than dependence on the West. It suggested that India should take a lead in areas like moon mining law and that once a clear law is established, INSPACE should be the one and only regulator.

Overall, Adv Ashok highlighted the complexity and challenges of developing and regulating the space industry, especially in the context of increasing private sector involvement. A clear and predictable space policy that reflects the convergence of current space activities and is guided by the principles of the Outer Space Treaty (OST), International Humanitarian Law (IHL), and domestic legal systems is essential.





Procurement Mechanisms for Catalysing Growth and Innovation

Keynote Address by Mr. Laxmesh BH,
Vice President & Head - Missiles & Aerospace
Business, L&T Defence, LARSEN & TOUBRO

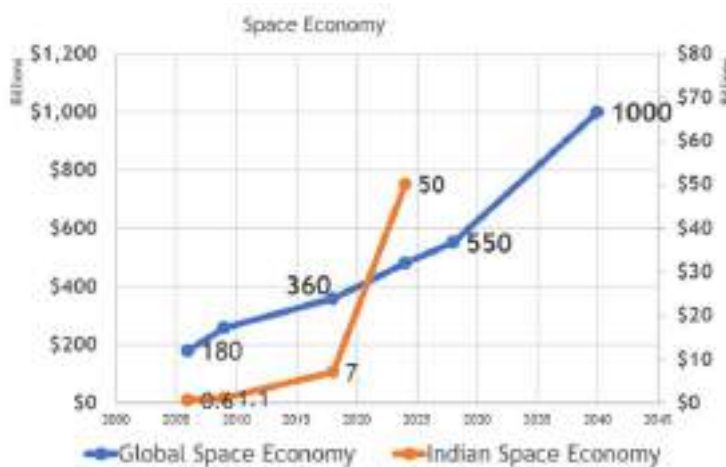


Mr Laxmesh’s speech focused on procurement mechanisms that can catalyse growth and innovation in the space market. He talked about how meeting the requirements of end customers is essential in the space market, which has two types of customers - those who use space for Earth and those who use space for space. The end customer for both cases is interested in information and data. Mr Laxmesh also pointed out that there is exponential growth in data consumption, which is redefining business trends.

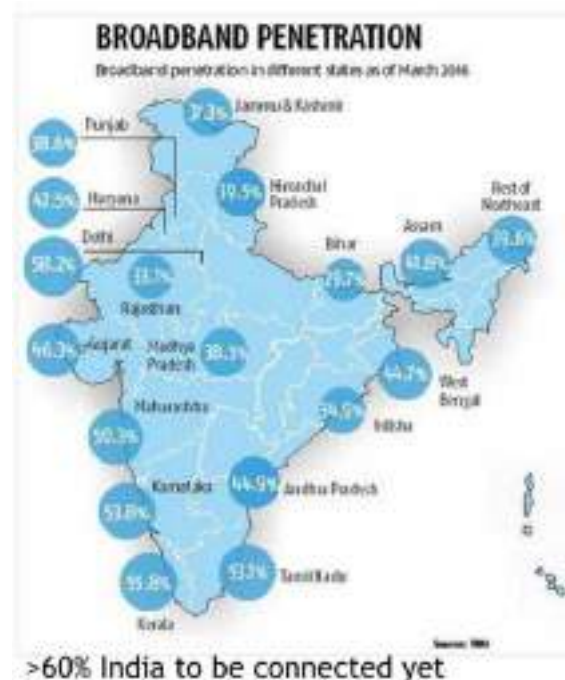
In India, the space sector is often referred to as the “Sunrise sector”, but a more accurate description may be the “Pre-Dawn” phase.

While there is hope for a bright future in the space industry in India, there is still much progress to be made.

Stage of Global Indian Space Economy



Space- A sunrise sector



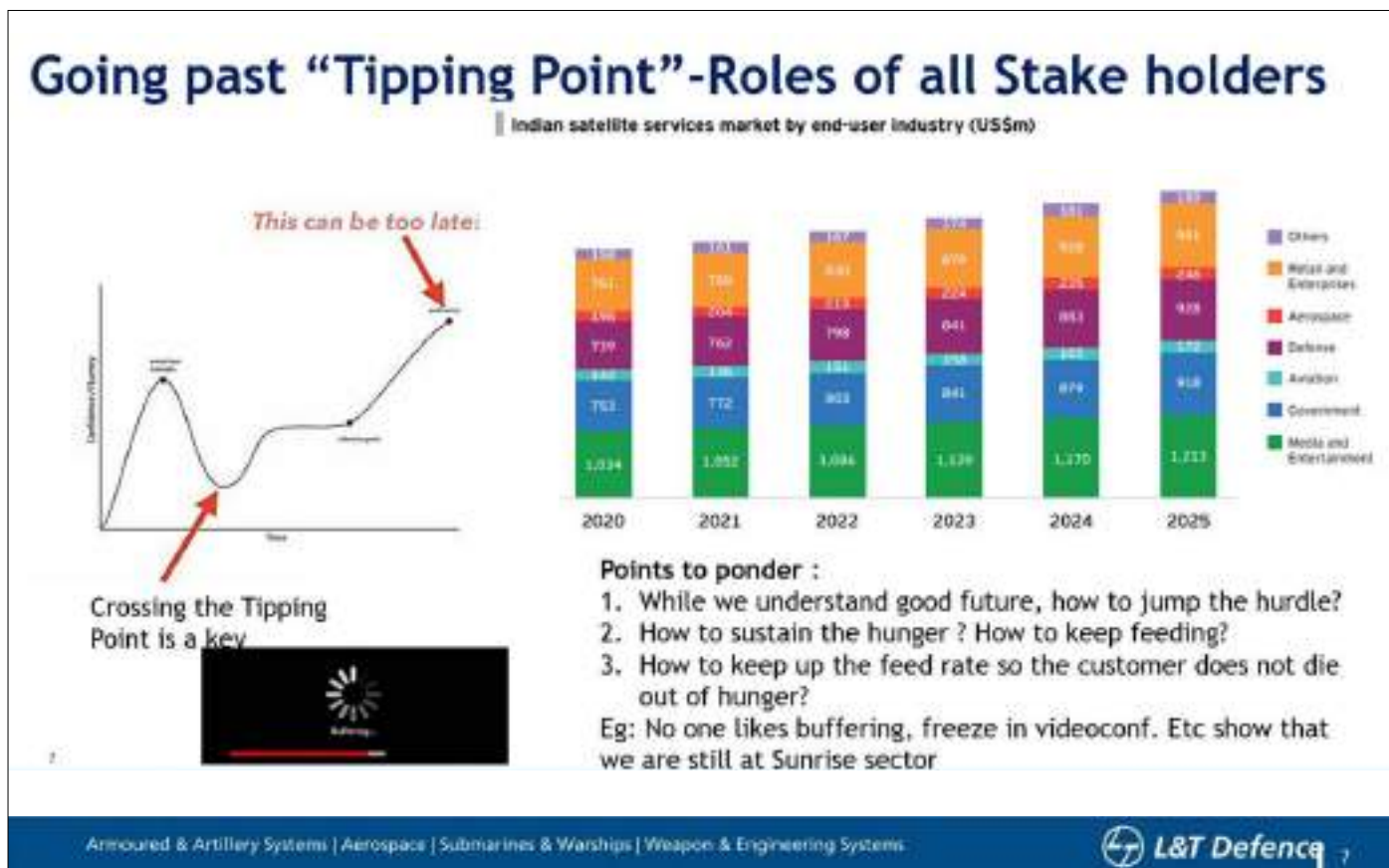
In the case of the space sector in India, it is important to note that while there are certainly some successes and advancements in the field, there is still a significant portion of the country that is not involved or connected to the industry.

Regardless of the specific reasons, the fact remains that over 60% of India's population is not yet connected to the space sector. Addressing this issue will be crucial for the continued growth and success of the industry in India. Efforts to expand access and opportunities, particularly in underrepresented or marginalized communities, will be key to unlocking the full potential of the space sector in India.

To create a successful space market, it is essential to understand the customers and

their data needs. It is worth noting that this data famine might lead to a data explosion in the future. As more individuals and communities gain access to the necessary tools and resources, there is significant potential for growth and innovation in the space sector and beyond. Despite the current challenges, there is reason to be optimistic about the future of the industry in India.

He believes that India is still in the pre-dawn phase of the space economy and that the sector requires more funding from regulated large financial institutes. India has only tapped 5% of the potential in this sector, and funding availability is a challenge because there is no clear idea of the market size. Most angel investors invest in the idea rather than the rate of return, which is why many investments do not mature.



Mr Laxmesh emphasized the importance of reaching a tipping point to achieve significant growth and progress in a particular field. This tipping point is characterized by a high level of resistance that must be overcome to move forward to an inflexion point, where growth and progress become exponential and self-sustaining. Governments around the world have increasingly recognized the potential of the space industry and are placing greater emphasis on its development. This is evidenced by recent initiatives taken by various countries.

One area that requires investment in the downstream market is the development of

data centres and decision-making systems at the edge. These systems would enable real-time analysis of data collected from space-based assets and provide valuable insights for businesses and governments.

In this context, India has the potential to excel in the space sector. The country has a large and talented workforce with expertise in technology and engineering. By investing in these areas, India can build a strong foundation for the growth of its space industry and take advantage of the opportunities presented by the downstream market.

Global Space models



USA (Space Policy 2004)

- **ULA:** Boeing & LM formed a JV for LV
- Govt Contracts thru NASA & AF –**Guaranteed Market**
- 5 New Private actors took lead role
- NASA : Space beacon and Industry coach



CHINA :

- State owned corporations CASC & CASAIC
- Private participation since 2014
- **VC's Losing patience in 3-5 years**



EU

- Safran, Ariane , EADS , Thales engaged with ESA
- Encouragement to SMEs was a welcome step
- EU Embraced Collaborative Growth
- **Public funding plays a large part of the investment.**



RUSSIA

- Most of the companies are descendants of Soviet Design Bureaus.
- Led by RKK Energiya, Khrunichev, TsSKB-Progress & NPO Lavochkin

One notable example is the United States government's creation of the "Space Commerce" office, which aims to advocate for the industry, remove regulatory barriers, engage with industry leaders, and improve understanding of the impact of space activities on Earth and mankind. This shift in focus has led to significant growth and innovation in the tech sector, as exemplified by NASA's transition from being a solution provider to a customer.

China has also made significant progress in their space agenda, driven by a strong government-led initiative that prioritizes investment in technology and infrastructure. They have developed their space capabilities, with a separate Sea Launch system exclusively for commercial payloads and the ability to decommission rogue space assets. However, these actions have been controversial.

The European Union has taken a collaborative approach, pooling public funds to invest in research and development projects. This has

enabled the EU to achieve significant progress in areas such as renewable energy and climate change mitigation. The updated space strategy of the EU includes policies related to the benefits of space activities for citizens and economic growth.

Russia has also faced setbacks, such as technology theft and program delays, but is expected to continue playing a significant role in the global space race. Overall, the increased attention and investment in the space industry by governments worldwide suggest a growing recognition of the sector's importance for future economic growth and innovation.

Overall, Mr Laxmesh's emphasis on the need to cross the tipping point and reach the inflexion point underscores the importance of overcoming resistance and investing in innovative solutions to achieve significant growth and progress in various fields.

DLPG stands for Deregulation, Liberalization, Privatization, and Globalization. This refers to



a set of economic policies aimed at reducing government intervention and promoting private sector growth. In the context of defence procurement, it means that the government plans to increase the involvement of private sector companies in the defence industry by allowing more market competition and reducing government control.

The announcement made during Aero India suggests that the government plans to open the defence space market in the next ten years, potentially allowing private companies to participate in this sector as well. This move


could lead to increased innovation, cost savings, and overall growth in the defence industry.

However, it should be noted that there has been little discussion about what topics should be discussed during an upcoming meeting or gathering about artificial intelligence.

Mr Laxmesh's predictions for the future include the significance of the defence space market and the increasing role of artificial intelligence (AI). He believes that AI will become more advanced and eventually take over some tasks currently performed by humans.

To ensure that India's growth rate is exponential after reaching the tipping point, Mr Laxmesh makes three main recommendations:

- ❖ **Engineering colleges should have system engineering as a discipline:** System engineering is a discipline that focuses on the design, development, and management of complex engineering systems. It involves integrating multiple components to create a cohesive and functional system. Engineering colleges should include system engineering as a discipline to help students gain a better understanding of how different components of a system work together.
- ❖ **AI data must be a compulsory minor:** With the increasing role of AI in various industries, Mr Laxmesh recommends that AI data must be a compulsory minor for students. This would help students learn how to collect and analyse data, which is a critical skill for developing AI systems.
- ❖ **Joint intellectual property (IP) should be encouraged:** Mr Laxmesh recommends that joint IP should be encouraged to promote collaboration between different entities. Joint IP refers to the ownership of intellectual property by multiple parties. This approach can help incentivize collaboration and allow different parties to benefit from the development of new technologies.



Key Takeaways from Session 2 Roundtable held under Chatham House Rules

During the second roundtable held under the Chatham House Rule, participants were reminded that they were free to use any information received but were prohibited from disclosing the identity or affiliation of any speaker or participant. Therefore, SIA-India has refrained from naming any speaker in the highlights presented below.

The speakers noted that the government has taken several steps to promote and regulate the sector, including the formation of the Indian National Space Promotion and Authorization Centre (IN-SPACe), which will oversee the promotion of the sector. Various assets of ISRO are being moved under the disposal of New Space India Ltd (NSIL). The Defence sector has set up its own Space Directorate/ agency. The upcoming Space Policy and Space Bill is expected to further promote the growth of the industry. To ensure the industry's growth, it is essential to identify the gaps in the sector and explore ways in which the government can support the space industry.

India has achieved significant success in launching satellites, conducting space missions, and developing indigenous space technology. Indian space start-ups have made remarkable strides, such as launching experimental rockets, developing orbital transfer vehicles, acquiring other companies, and launching their satellites. However, critical challenges persist in the sector, including limited access to capital, difficulty in acquiring skilled human resources, policy challenges, support from ISRO and DoT, and market access, which need to be addressed to ensure sustained growth.

While India has established itself as one of the six major space-faring nations globally, it has

yet to catch up with many developments and technology trends in the sector in recent years.

The US government has been a major driver of the growth of commercial space activities, with periodic policy initiatives like the Commercial Space Launch Act (1984) and the National Space Policy (1996). With a space budget of over 30 billion USD in 2023 and almost 50% of the world's space companies based in the US, it's no surprise that most of the investments in the sector happen there. In contrast, India has yet to venture into the small satellite area, with only 5% of all satellites launched in 2022 being large ones. To catch up, India needs to enhance ISRO's budget, become a true anchor enabler and promoter of the private sector, and transfer technology to the domestic industry at an affordable fee. The proposed budget allocation for the space industry in India for 2023-24 has gone down by 9.2% compared to last year's proposed budget. It remains to be seen whether the government will be able to provide the necessary funding to support the growth of the industry.

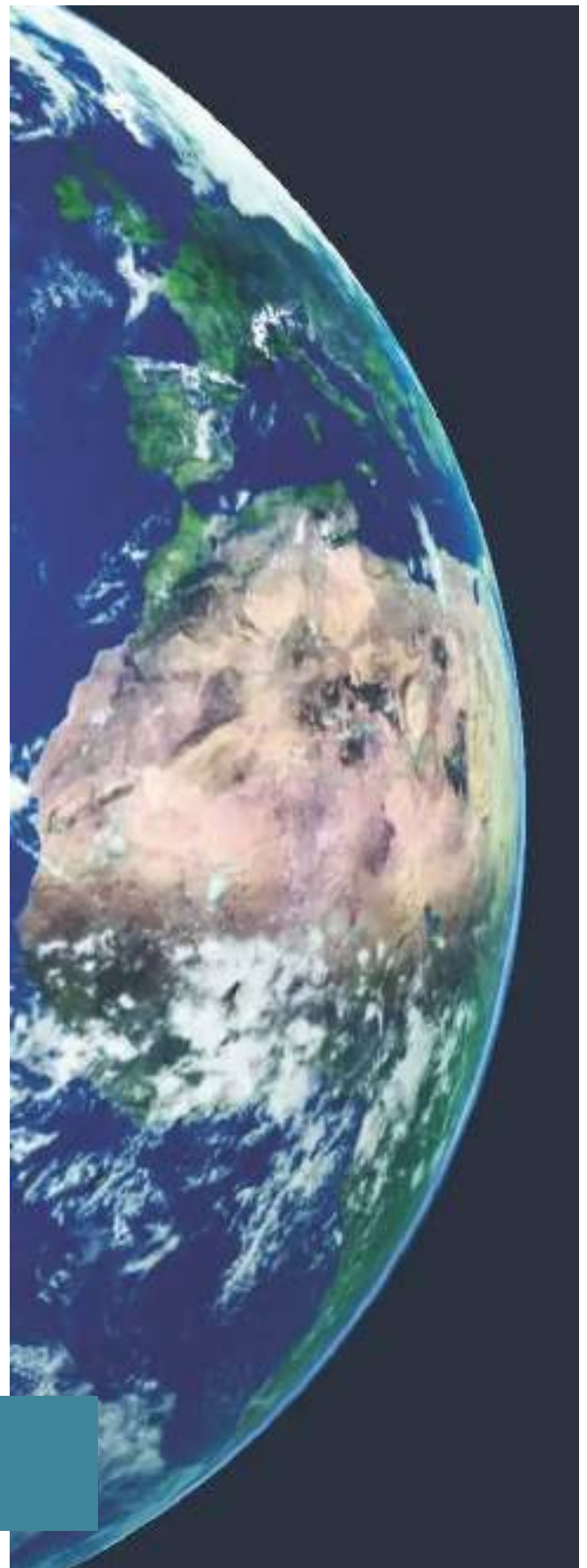
The US and Europe are already integrating upstream activities in the space sector, such as manufacturing and launching satellites, with no taboo towards the industry. The Indian government needs to foster collaborations between the Indian and foreign space

industries to bring in advanced technologies. A skilled workforce and greater market access will also be key to achieving sustained growth in the sector. Additionally, a demand and supply assessment is necessary to make informed investment decisions and secure global contracts.

Currently, Indian satellites meet only about 30% of the country's demand for remote sensing data, with the remaining 70% being sourced from external entities. The government must leverage the strengths of the domestic industry to the fullest extent to reduce this dependence. Developing GPS/positioning satellites represents an opportunity for the domestic industry, and a comprehensive assessment of the industry's capabilities and gaps can guide future decisions by the government. Policy briefs should be generated to support the growth of the industry. Finally, timely access to technology services and continuity of service should be addressed to ensure sustainable growth.

Transfer of Technology from ISRO to the domestic industry at an affordable fee and joint improvement of the tech products together with them are equally important, as is skilling people in large numbers to get into space sector activities. Fostering collaborations between the Indian and foreign space industries to bringing-in contemporary and advanced technologies is also essential.

The Indian space industry must tackle these challenges head-on to ensure continued success and growth. Greater market access and the development of a skilled workforce will be key to achieving sustained growth in the sector. By taking proactive steps to address these challenges, the Indian space industry



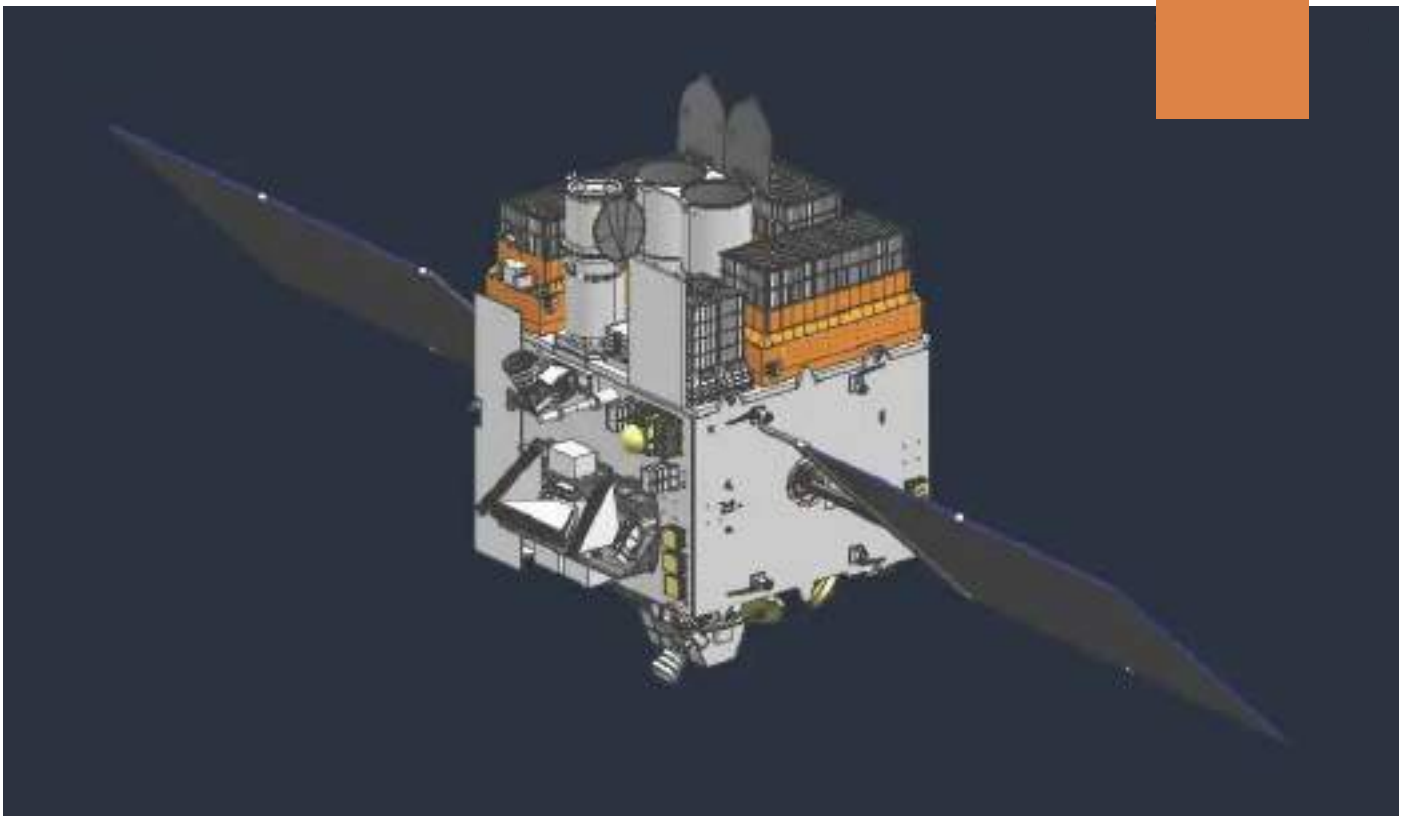
can pave the way for a bright and promising future.

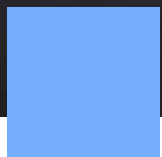
Regarding the contribution of the space program to India's GDP, it was discussed that there are both implied and actual benefits. The current size of India's space economy is estimated to be around 33,000 crore rupees, with the government spending approximately 12,543.91 crore rupees on the sector, representing about 2.5% of the total space economy's size.

The potential for significant growth in the space economy was highlighted, ranging from 10% to 15%. While the downstream sector has been generating revenue, creating new markets is essential to sustain financial growth. However, there is a need to develop a roadmap for realizing the industry's full potential.

India needs to create new markets and look for opportunities that are larger than the revenue currently being generated; despite the low volume, the industry can still create a significant impact. Intellectual property (IP) needs to be generated and owned by private industry, like how it is done abroad. Currently, only 15% of revenue comes from manufacturing, while 60% is from downstream applications. Cross-subsidization of potentials between sectors would be necessary to ensure the longevity of the industry.

A focus on industry correction, IP regulations, and preparedness would be vital for the industry's growth. However, creating a roadmap for realizing the full potential of the space sector remains an important challenge. Additionally, the need for data centres to manage the growing volume of data was





emphasised. As India does not currently have large cloud-based data centres.

Further in the discussion, the Indian space industry and related policy interventions were discussed, including the role of the National Institute of Advanced Studies (NIAS) in research studies and policy interventions in the space and defence sectors. The liberalization of the space sector has created new opportunities for Indian space startups to collaborate with international partners and work on cutting-edge projects to advance the country's space capabilities.

India's space program has three main areas of focus: communication, navigation, and Earth observation (EO). One example of this is the EOS-6, India's third-generation satellite under the Oceansat series, which will collect ocean colour and sea/ocean surface temperature data. The Ministry of Earth Sciences is financing this project, and the data generated by the satellite will be used for various purposes. In addition, line ministries such as Agriculture and Forest are funding the space sector and using data from different satellites for applications such as agriculture, forestry, disaster management, and more.

During the discussion, recommendations were made for the Indian space industry to ensure its sustainability, one of which was to focus on developing reusable launch vehicles (RLVs) to increase launch capabilities and capture a significant portion of the market by 2030. The need for India to develop RLVs was emphasized, to capture approximately 10% of the market by 2030. India's launch vehicles are cost-effective, and the country plans to launch 58,000 satellites by 2030. To accommodate these satellites, it is crucial to reduce their size

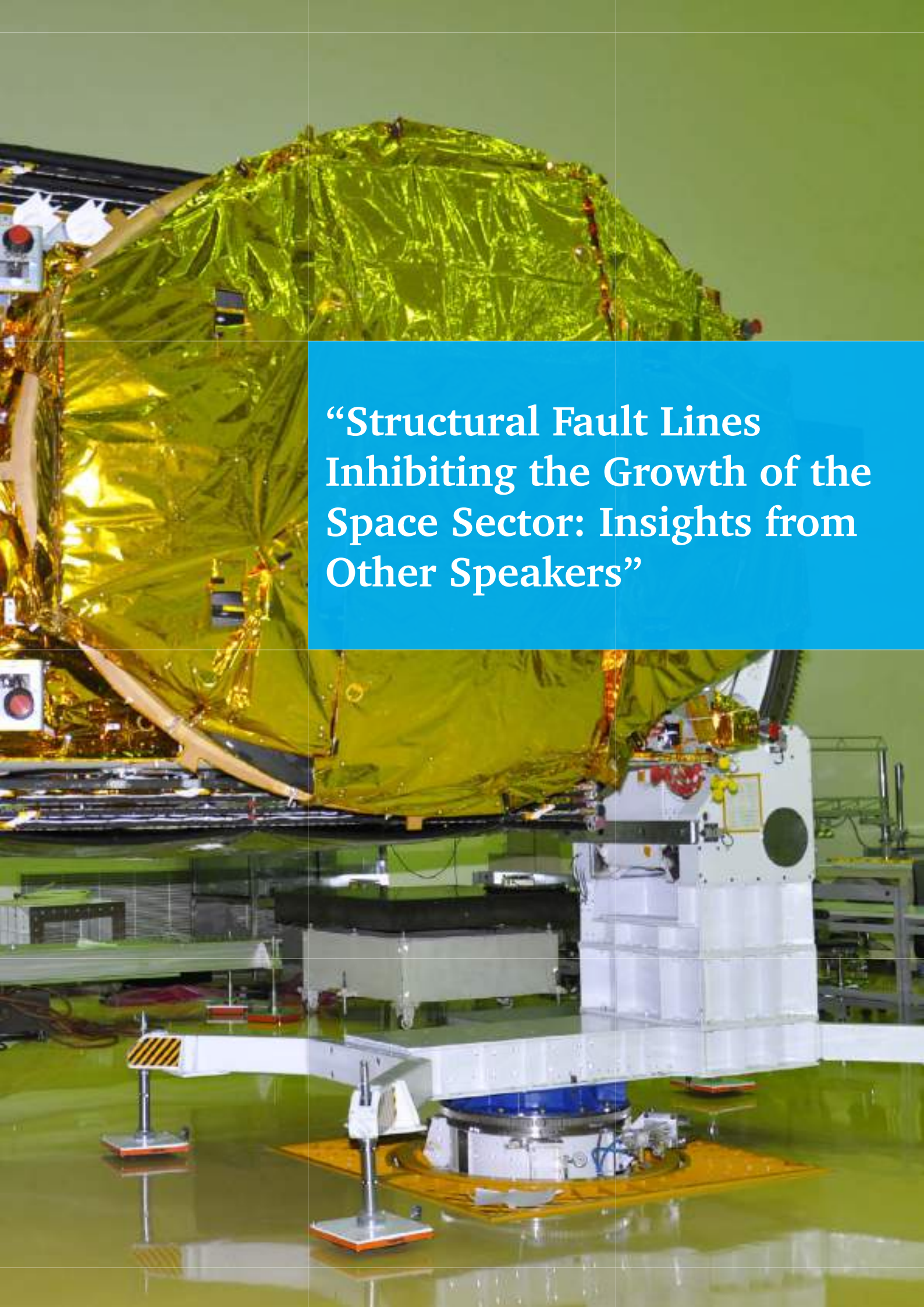
and develop RLVs with the ability to launch on-demand beyond low-earth orbits. The ISTAC consortium at IIT Madras is working to develop these launch capabilities.

Small satellites and quick launch capabilities are essential for deriving multiple applications. The satellite market and launch capabilities should bring value to investments and address industry needs, while capacity building should start with a forecast for the upcoming decade.

The discussion also highlighted the need for a regulatory framework that ensures control and accountability in the Indian space sector, adhering to international export control regimes. The GOCO model was suggested as a potential solution to sustain the industry, and there was an emphasis on the importance of clarity on international property rights for all kinds of technologies and their applications. Collaboration between public and private players was stressed, along with a clear understanding of the demands and challenges of the sector.

The essentiality of applications for civil-military purposes was also highlighted, including the ability to detect missile launchers from LEO, high-tech sensor detection, and communication with other satellites and defence satellites. The importance of a regulatory framework that ensures control and accountability in the Indian space sector was also discussed, including adherence to international export control regimes.

Overall, a nuanced approach to these strategies can help build a better understanding of India's capabilities and intentions, creating a more equitable and sustainable economic relationship.



**“Structural Fault Lines
Inhibiting the Growth of the
Space Sector: Insights from
Other Speakers”**

Access to capital is critical for the growth and development of the Indian space industry. Currently, the industry is heavily dependent on government funding, which has been declining in recent years.

At the same time, Indian investors with deep pockets are also essential for the industry's growth. However, as of now, Indian angel investors have contributed to units of millions, while foreign investments are in the tens of millions. This indicates that **Indian investors are still hesitant to take the risk of investing in space activities.**

Angel investors often invest based on the potential of the idea rather than the rate of return. While this approach can be beneficial, it also carries risks. Many investments in the space industry do not mature because they are too early-stage or too risky, which can lead to a lack of funding for promising ideas.

Moreover, the long development cycles of space projects can make it challenging to attract investors who want quick returns on investment. Investors may be reluctant to commit to long-term projects that take years to develop and are uncertain of success.

Overall, the lack of funding available due to the uncertainty of the market size and the long development cycles of space projects are significant challenges for entrepreneurs in the space sector. While angel investors can provide valuable funding, more support is needed to bridge the funding gap and foster innovation in this emerging industry.

It is worth noting that the number of companies involved in upstream activities is slightly more

than those involved in downstream activities. This is a matter of concern as downstream activities have a more significant impact on the economy and provide more opportunities for private sector involvement. Therefore, there is a need to encourage more private-sector investment in downstream activities.

Challenges faced by Indian companies abroad:

It was stated that Indian companies in the space and defence industries face several challenges when doing business abroad. One major challenge is competing with government-supported companies from other countries. This may make it difficult for Indian companies to enter the global market and succeed. To overcome this challenge, there is a need for leveraging power with other countries and collaborating with foreign entities.

Indian companies need to develop ground/downstream capabilities. The ground support for NAVIC is understudied, and the Satcom industry is much ahead of the cellular industry. Indian companies need to aggressively pursue the development of ground equipment to be competitive in the global market.

Godrej Aerospace is an Indian company that produces engines for small rockets and collaborates with DRDO and BRAHMOS in defence. Despite its successes, the company faces challenges due to multiple inspections that restrict the time and value addition of its



capabilities. Therefore, the company focuses on developing its processes, using the Process Failure Mode and Effects Analysis [PFMEA] to obtain approvals to move forward.

Indian companies also lack R&D and engine standards when compared to global standards. Collaboration with foreign entities is essential to overcome these challenges, but procuring technologies from countries like Russia can draw sanctions. This means that Indian companies need to be careful in their collaborations to avoid being penalized for sanctions violations.

In some cases, Indian companies have accepted protection from such sanctions to continue their collaborations with foreign entities. This is because procuring technologies and expertise from foreign entities is essential to improve their R&D and engine standards.

Boosting investor confidence:

The Indian space industry has the potential for significant growth, but boosting investor confidence is crucial to achieving this goal. Currently, most Indian investors are risk-averse and prefer safer investments over long-term, high-risk investments in space technology. As a result, many startups in the space industry struggle to secure larger funding beyond the pre-seed and seed stages, and the bubble of space industry euphoria may burst at any time.

To address this issue, Indian investors need independent think tanks that can study the upstream and downstream space markets and provide them with an independent assessment of the prospects of a company entering the space industry. Without such assessments, investors are left to study the business plans of prospective industries. While a good business plan may attract investors, it is not a guarantee of success.



Indian investors need to be educated on the potential of the space industry and the risks and rewards of investing in it. Independent assessments of prospective companies entering the space industry are also necessary to guide investment decisions.

Finally, the Indian government needs to prioritize the development of the space industry and resolve FDI issues to attract foreign investors.

While companies have access to global funding through trade policies, India lacks sufficient incubation centres to support nascent industries. Increasing grants and expanding incubation centres can encourage potential entrepreneurs to leap.

Two important topics related to the Indian space industry were highlighted:

Government support for tech acquisition and the Production-Linked Incentive (PLI) scheme:

Regarding government support, speakers emphasized the importance of protecting Indian

companies during technology acquisition from foreign countries. It was suggested that the government should provide more support and incentives to Indian companies to acquire and adopt foreign technologies, particularly in the space sector. This is crucial because the global space industry is highly competitive, and Indian companies need access to the latest technologies to remain competitive.

Production-Linked Incentive (PLI) scheme, which is a government initiative aimed at increasing the output of various sectors, including the space industry. The scheme provides financial incentives to companies that produce high-quality products, thereby increasing their productivity and competitiveness. PLI scheme can play a critical role in boosting the Indian space industry's growth by providing financial incentives to companies that produce high-quality space products.

The Need for Realistic Analysis and Comprehensive Policies:

Speakers highlight several challenges facing the space sector in India. One of the primary issues is the delay in the implementation of a

comprehensive space policy. While there have been several announcements and statements made about the government's plans for the sector, the actual implementation has been slow and disjointing. This has led to uncertainty and confusion among industry players, who are unsure about the direction of the sector and the government's plans for supporting it.

Another challenge is the prevalence of overly optimistic statements about the sector, without sufficient analysis or realistic estimates. While it is important to be ambitious and optimistic about the potential of the space sector, it is also critical to have a realistic understanding of the challenges and limitations that must be overcome to achieve success. Without proper planning and analysis, it is difficult to make informed decisions about investment, policy, and strategy.

The Lack of values and estimates for the space sector is a major challenge. It is essential to have a clear understanding of the potential

market size, demand, and other key factors to make informed decisions about investment, policy, and strategy. Without this information, it is difficult to attract investment, develop effective policies, or build a strong and sustainable space sector. Therefore, the government and industry players must work together to gather data and conduct research to develop a clear and realistic understanding of the space sector.

Recognizing Space Systems as Critical Infrastructure:

The space system is an integral part of the communication infrastructure. It includes various components such as satellites, ground stations, and communication networks. These systems are essential for communication, navigation, remote sensing, and weather forecasting. The space system is a critical infrastructure that supports various industries such as telecom, broadcasting, defence, and disaster management.



Therefore, the government needs to recognize the space system as a part of the infrastructure and undertake its development and management accordingly. The government needs to provide adequate funding, policy support, and a regulatory framework to develop a robust and sustainable space system.

Moreover, the government needs to collaborate with the private sector to leverage its expertise and resources in the development and operation of space infrastructure projects. By providing adequate policy support and regulatory framework, the government can leverage the private sector's expertise and resources to develop a robust and sustainable space system that can support the overall development of the country.

India's leadership of G20: Promoting Space Partnerships for Global Growth

As India takes on the role of chairing the G20, it has a unique opportunity to engage in discussions regarding the global space sector. The talks would focus not only on India's space program but also on the programs of other G20 member nations. Collaborative initiatives, such as resource-sharing and mutually beneficial agreements, could result from these discussions between countries with established space programs and those seeking to develop them.

It is also important for India to engage in discussions regarding the integration of military and civilian space sectors, as space technology plays a significant role in modern warfare. Collaboration could help countries better develop and deploy space-based defence applications, especially in light of China's significant growth in its space program, which is viewed as a potential threat to other nations.

India's vision of holistic growth and addressing global challenges, such as climate change, public health, and sustainable development, can be advanced through the use of space technology. However, there are challenges that India must overcome to fully leverage the benefits of its G20 and Shanghai Cooperation Organization (SCO) presidencies and its space industry's potential.

With three space agencies operating in India, geopolitical factors at play, and a lack of understanding of industry needs, various line ministries have differing demands for space technology. Additionally, the space industry must generate intellectual property, and government expenditure in the space economy as a percentage of the national GDP must increase. To fully realize the potential of its space industry, India must adopt the GOKO model and establish export control regimes to prevent industrial espionage.

A regulatory environment is crucial, and the Indian Space Research Organisation (ISRO) must take a leading role in guiding and supporting the industry towards the next phase of growth. India has an opportunity to collaborate with other G20 nations to bridge the gap in space capabilities and promote economic mechanisms that support the development of space competence in developing countries.

India can employ policy interventions, procurement mechanisms, and civil-military fusion strategies to position its space commerce for further growth and innovation in the era of global supply chains and geopolitical uncertainty. In conclusion, India's G20 presidency offers a significant opportunity for the country to lead the way in promoting space partnerships for global growth.



Key Recommendations

Space technology, Indigenisation, research, and development:

- ❖ Enhance capabilities in space technology, research, and development, and innovation to position India as a leader in space commerce.
- ❖ Explore opportunities to build supply chains or collaborate with other countries to enhance capabilities in satellite fabrication and launch.
- ❖ India needs to establish its defence space capabilities to gather accurate and timely intelligence, especially in times of war.
- ❖ Secure communication is of utmost importance in military data, and cyber, AI, and ML can aid in the development of an Internet of Military Things and an Internet of Battle Things.
- ❖ India must strive for global standards in military technology to ensure the best possible capabilities for its military.
- ❖ Indigenization is essential for long-term security, and industry must be supported to develop niche and cutting-edge technology to meet military needs.
- ❖ Focus on developing reusable launch vehicles (RLVs) to increase launch capabilities and capture a significant portion of the market by 2030
- ❖ Develop small satellites and quick launch capabilities to derive multiple applications and bring value to investments
- ❖ Transfer of technology from ISRO to the domestic industry at an affordable fee is essential.
- ❖ Leverage the strengths of the domestic industry to reduce dependence on external entities for remote sensing data.
- ❖ Develop GPS/positioning satellites to represent an opportunity for the domestic industry.

Space policy and regulations:

- ❖ Conduct research and gather data to develop a clear and realistic understanding of the space sector's potential market size, demand, and other key factors to make informed decisions about investment, policy, and strategy.
- ❖ Conduct a comprehensive review of existing space policies and regulations to identify areas that need improvement, including the need for a more diverse policy-making team.
- ❖ Develop a clear and predictable space policy that reflects the convergence of interests in today's age and considers the importance of trade as a tool in geopolitics.
- ❖ Shift away from over-regulation towards more effective regulation that does not intimidate the private sector but ensures safety and accountability.
- ❖ Foster collaboration between the government and private sector to promote self-reliance and technology development.
- ❖ Provide thought leadership in policy by engaging with international organizations, experts, and industry leaders to develop innovative and forward-looking approaches.

- ❖ Develop a regulatory framework that ensures control and accountability in the Indian space sector, adhering to international export control regimes and emphasizing clarity on intellectual property rights for all kinds of technologies and their applications.
- ❖ Establish a regulatory environment and adopt the GOKO model, as well as export control regimes, to prevent industrial espionage.
- ❖ Decentralize the role of ISRO and develop a legal framework to enable the growth of the space industry in India.
- ❖ Boost the Indian space industry's growth by providing financial incentives through the Production-Linked Incentive (PLI) scheme to companies that produce high-quality space products.
- ❖ Recognize the space system as a critical infrastructure and provide adequate funding, policy support, and regulatory framework to develop a robust and sustainable space system.
- ❖ Address industry correction, IP regulations, and preparedness to ensure that industries operate in a way that is sustainable, legal, and secure.
- ❖ Encourage the participation of younger voices in the community in policy-making and decision-making processes.
- ❖ Establish laws that govern space commerce before developing policies to support or implement those laws, to provide policies with a solid legal foundation.
- ❖ Address the issue of a significant portion of the population not being connected in India. Efforts should be made to expand access and opportunities, particularly in underrepresented or marginalized communities.
- ❖ Enhance ISRO's budget to provide the organization with adequate funds to support its R&D activities, execution of space missions, developing advanced technologies, attract and retain top talent, invest in new infrastructure, and establish partnerships with other space organizations around the world, further advancing India's position in the global space industry.

Space Diplomacy

- ❖ Utilize the benefits of space technology to advance India's vision of holistic growth, and work towards solving global challenges such as climate change, public health, and sustainable development.
- ❖ Encourage collaboration between Indian companies in space and defence industries and foreign entities to overcome the challenges faced in competing with government-supported companies from other countries.
- ❖ Engage in discussions with other G20 member nations to explore resource-sharing and mutually beneficial agreements in the global space sector, as well as the integration of military and civilian space sectors.
- ❖ Allocate adequate funding to ISRO to establish partnerships with other space organizations around the world, further advancing India's position in the global space industry.

Military Technology:

- ❖ Use space technology to build smart frontiers that provide a common operating picture and cover key land and sea locations to enhance military capabilities.
- ❖ Focus on providing modified civilian capabilities, such as more focused and detailed ISR data, to meet the military's needs and enhance situational awareness.
- ❖ Develop secure communication channels for military data, and leverage cyber, AI, and ML to develop an Internet of Military Things and an Internet of Battle Things for better integration and coordination among military assets.
- ❖ Adopt global standards in military technology to ensure the best possible capabilities for India's military, and support industry to develop niche and cutting-edge technology to meet military needs while promoting indigenization.
- ❖ Develop applications for civil-military purposes, including missile detection from low Earth orbit [LEO], high-tech sensor detection, and communication with other satellites and defence satellites.
- ❖ Invest in R&D and innovation to develop next-generation military technologies, such as directed energy weapons and hypersonic missiles, to stay ahead of emerging threats.
- ❖ Establish robust testing and evaluation processes to ensure the reliability, safety, and effectiveness of military technology before deployment.
- ❖ Establish collaborations with allied countries and partners to share technology and knowledge, and to jointly develop advanced military capabilities.
- ❖ Provide adequate funding, policy support, and regulatory framework to develop a self-sufficient and sustainable military technology industry in India.

Investment and funding:

- ❖ The Indian government and private companies should prioritize investing in R&D and building indigenous capabilities to foster innovation and economic growth.
- ❖ Building and supporting Industry 4.0 to reach 5.0 and aggregating unused data for India's use under space diplomacy is critical to India's success in the space sector.
- ❖ The space sector requires more funding from regulated large financial institutes. Efforts should be made to encourage investment in the sector.
- ❖ Funding availability is a challenge as there is no clear idea of the market size. India should take proactive steps to encourage investment in the space sector by conducting a thorough market analysis to determine the potential demand for space-based products and services.
- ❖ Efforts should also be made to create awareness among investors about the opportunities in the sector and the potential for growth.
- ❖ Additionally, the government can consider offering tax incentives and other financial benefits to investors to further encourage investment in the sector

- ❖ Increasing grants and expanding incubation centers can encourage potential entrepreneurs to leap into the space industry.
- ❖ Boosting investor confidence is crucial for the growth of the Indian space industry, which can be achieved through independent think tanks, education on the potential of the industry, and resolving FDI issues.

Investment in the downstream market:

- ❖ Indian companies should develop ground capabilities and invest in ground equipment to be competitive in the global market, specifically to support satellite systems such as NAVIC and catch up with the Satcom industry.
- ❖ Investment in the development of data centers and decision-making systems at the edge is crucial to manage the growing volume of data collected from space-based assets. This would enable real-time analysis and provide valuable insights for businesses and governments.
- ❖ Encourage private sector investment in downstream activities through incentives, tax breaks, and policy measures to promote investment in these areas.
- ❖ To achieve significant growth and progress in the space sector and beyond, India must overcome resistance and invest in innovative solutions.
- ❖ There is a need to encourage more private sector investment in downstream activities through incentives, tax breaks, and other policy measures that promote investment in these areas

Education and workforce development:

- ❖ Engineering colleges should include system engineering as a discipline to help students gain a better understanding of how different components of a system work together.
- ❖ AI data must be a compulsory minor for students to learn how to collect and analyse data, which is a critical skill for developing AI systems.
- ❖ Develop a skilled workforce and greater market access to achieve sustained growth in the sector.
- ❖ Establish partnerships with leading space organizations and universities worldwide for knowledge sharing, student exchanges, and joint research projects.

Collaboration and partnerships:

- ❖ Focus on building partnerships and promoting global cooperation, fostering better relationships between nations, and ensuring effective governance and leadership to implement policies and strategies efficiently
- ❖ Joint intellectual property (IP) should be encouraged to promote collaboration between different entities in the development of new technologies.

- ❖ The government should allow more market competition and reduce government control to increase private sector involvement in the defence industry.
- ❖ Adopt best practices such as the European Union’s collaborative approach to investing in research and development projects. The approach has enabled the EU to achieve significant progress in areas such as renewable energy and climate change mitigation.
- ❖ Indian companies lack R&D and engine standards, which can be overcome by collaborating with foreign entities, but caution is needed to avoid sanctions violations.
- ❖ Developing international standards and protocols for space activities can help to promote collaboration and reduce the likelihood of conflicts in space.



Agenda - Annexure 1



Agenda

START	END	DESCRIPTION
09:30	10:30	Welcome Address – Dr Subba Rao Pavuluri, President SIA-India and CMD Ananth Technologies Inaugural Address – Dr Shailesh Nayak, Director, NIAS
10:30	11:00	Keynote address - Positioning India's Space Commerce in the era of Global supply chains amid the Geopolitical Flux. Amb. Rakesh Sood, Fmr Ambassador and Foreign Policy and Strategic Affairs Expert
11:00	11:30	Keynote Address - Mitigating the Structural fault lines that inhibit private sector growth in the space industry Adv. Ashok GV, Managing Partner, Factum Law
11:30	12:00	Break for Tea
12:00	12:30	Keynote Address - Demand Creation and innovative models for sectoral growth Mr. Laxmesh BH, Head- Missiles and Aerospace, L&T Defence
12:30	13:00	Keynote Address - Preparing a Civil-Military Integration Catapult for Space sector industrialization. Lt. Gen. P J S Pannu, PVSM, AVSM, VSM (Retd) Former Deputy Chief Indian Integrated Defence Staff (Operations), Distinguished Fellow USI
13:00	14:00	Break for Lunch
14:00	14:15	Summarising Keynotes – Dr. Chaitanya Giri, Associate Professor, FLAME University and Consultant RIS
14:15	16:30	Roundtable Discussion - Industrialisation of India's Space Capabilities
16:30	16:45	Vote of Thanks and Closing address – Mr. Anil Prakash, Director General, SIA-India
16:45	17:15	Break for Tea

Organising Committee

1. Dr. Shailesh Nayak, Director, National Institute for Advanced Studies
2. Dr. Subba Rao Pavuluri, President SIA-India & CMD, Ananth Technologies Limited
3. Dr. V.S. Hegde, Former Scientific Secretary, ISRO; Former CMD, Antrix Corporation
4. Prof. Chaitanya Giri, Associate Professor, FLAME University and Consultant RIS
5. Mr. Anil Prakash, Director General, SIA-India
6. Mr. Rajeev Gambhir, Sr. Director, Technology & Policy, SIA-India



About NIAS

The National Institute of Advanced Studies (NIAS) was conceived and founded in 1988 by the late Mr. JRD Tata, who sought to create an institution to conduct advanced, multidisciplinary research. The philosophy underlying NIAS is given shape by its multidisciplinary research teams bringing together individuals from diverse intellectual backgrounds, in the natural and life sciences, humanities, social sciences, and conflict and security studies. The objective is to nurture a broad base of scholars, managers and leaders who would respond to the complex challenges that face contemporary India and global society, with insight, sensitivity, confidence and dedication. The Institute is unique in its integrated approach to the study of interactions between science and technology, philosophy, social issues and leadership. Visit Website: www.nias.ac.in



About SIA-India

SIA-India is a non-profit organization representing the interests of the space industry in India. Our membership includes satellite operators, manufacturers, suppliers, startups, academic institutions, and law firms. The association is committed to serve as a voice for the industry and represent the industry's interests at policy making and regulatory bodies. SIA-India also offers a platform to forge international collaborations and provides an interface with the government. Visit Website: www.sia-india.com

Principal Partner



About Ananth Technologies Ltd.

Ananth was incorporated in 1982 to support the growth of the Indian economy through leveraging aerospace technologies. Our main offerings include the manufacture of critical aerospace systems and high-value geospatial services. These products and services have been both internationally certified (ISO 9000 & ISO 9001:2008) and recognized by our clients.

Ananth is a sizing and reliable partner in both the local and global aerospace supply chains. Ananth contributed to 62 satellites and 72 launch vehicles. In addition, Ananth's Geospatial services enable activities across the spectrum from town planning to infrastructure building. Expertise, Quality, and Focus are the guiding principles at Ananth. Visit Website: www.ananthtechnologies.com

DEFSAT
19 & 20 April 2023
New Delhi



**12th-14th
July 2023**
NEW DELHI

Agenda - Annexure 2



LIST OF PARTICIPANTS

- ❖ Dr Shailesh Nayak, Director, National Institute of Advanced Studies (NIAS)
- ❖ Dr Subbarao Pavuluri, President SIA-India and CMD Ananth Technologies Limited
- ❖ Ambassador Mr Rakesh Sood, Foreign Policy and Strategic Affair Expert
- ❖ Advocate Ashok GV, Managing Partner, Factum Law
- ❖ Mr Laxmesh Hasanabadi, Vice President & Head - Missiles and Aerospace Business, L&T (Defence)
- ❖ Lt Gen PJS Pannu (Retd.), PVSM, AVSM, VSM(Retd) Former Deputy Chief Indian Integrated Defence Staff (Operations) and Chair of the Aerospace and Defence Committee at SIA-India
- ❖ Prof Vinay K Dadhwal, Indira Gandhi Chair Professor of Environmental Sciences, National Institute of Advanced Studies (NIAS)
- ❖ Dr VS Hegde, Former Scientific Secretary, Indian Space Research Organisation (ISRO) and Chairman and Managing Director (CMD), Antrix Corporation Ltd
- ❖ Prof. PG Diwakar, ISRO Chair Professor, National Institute of Advanced Studies (NIAS)
- ❖ Dr V Siddhartha, Former Secretary of the Science Advisory Council to the Prime Minister of India and Adjunct Faculty, School of Conflict and Security Studies, NIAS
- ❖ Prof. Satya Chakravarthy, Head, National Centre for Combustion Research and Development (NCCRD) & Professor of Aerospace Engineering, Indian Institute of Technology (IIT) Madras
- ❖ Dr Chaitanya Giri, Consultant, Space Policy & Diplomacy, Research and Information System for Developing Countries (RIS)

OTHER ATTENDEES:

- ❖ Mr Vivek Kimbahune, Executive Vice President, Saankhya Labs
- ❖ Ms Sandhya Thyagrajan, Vice President, Strategic Electronics Business Unit, Centum Electronics Limited
- ❖ Mr KT Ramesh, Additional General manager, Space Projects, Alpha Design Technologies Pvt. Ltd.
- ❖ Mr Abhishek Malhotra, Managing Partner, TMT Law
- ❖ Prof Rajaram Nagappa, Honorary Visiting Professor, School of Conflict and Security Studies, National Institute of Advanced Studies (NIAS)
- ❖ Prof. P M Soundar Rajan, Former Director, Defence Avionics Research Establishment (DARE), DRDO; Visiting Professor, ISSSP, National Institute of Advanced Studies (NIAS)
- ❖ Mr Paurush Bhesania, Head of Marketing, Godrej & Boyce Manufacturing Company Limited
- ❖ Dr Nitin Gokhale, Founder, StratNews Global
- ❖ Mr Anil Prakash, Director General, SIA-India
- ❖ Mr Rajeev Gambhir, Sr. Director – Technology and Policy, SIA-India
- ❖ Sudipta Behera, Sr. Analyst Public & Economic Policy, SatCom Industry Association
- ❖ Harini Madhusudan , Doctoral Researcher, National Institute of Advanced Studies



SIAINDIA
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