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International Conference & Exhibition on Space 2021

September 13-15, 2021

'Building Newspace in India'

OUTCOME REPORT

EXECUTIVE SUMMARY

India's space sector has the potential to gain double digit share of the $440 billion global space economy that itself is expected to scale the $1 trillion level by 2040. The opening up of the sector to private participation has set in motion a new wave of entrepreneurship in areas like building and launching launch vehicles and satellites, developing satellite-based services and ground-level systems, undertaking R&D, and supporting mission services. The 3-day **International Conference & Exhibition on Space 2021** on the theme **'Building Newspace in India**, hosted on the CII Hive virtual platform during September 13-15, 2021, directed laser focus on the growth catalysts for the Indian newspace economy.

In the **Inaugural Session**, it was cited that in this emerging scenario, the Indian National Space and Authorization Center (IN-SPACe) under the leadership of Dr Pawan Goenka is expected to play a pioneering role in furthering the joint efforts of ISRO and Indian industry and start-ups to leverage the emerging commercial opportunities in the space sector. IN-SPACe will be focused upon providing greater policy and regulatory clarity to industry, promoting private investment opportunities, identifying new space technology applications, ensuring seamless coordination between the different space agencies, opening up overseas markets for domestic suppliers, facilitating cross-deployment of technologies, among others.

The Government is also reviewing the FDI norms governing the space sector in the effort to attract the participation of foreign companies in both the upstream and downstream segments of India's space industry. As a case in point, the deliberations brought forth the scope of bilateral cooperation between India and the Netherlands for space technology application in areas like monitoring of air quality and climate, earth observation in the realms of water resources and agriculture, miniaturisation and development of nano satellites, and manufacturing of components and sub-systems. It was also cited that there is Immense scope for deep collaboration between Australian and Indian companies engaged in space technology and applications.

While the opening up of the sector has paved the way for several startups to enter the newspace economy, the experts addressing the conference pointed out that the new businesses may be encouraged to tap into the greater commercial opportunities extant in the downstream activities of space technology and applications.

The session on **'Shaping future with geospatial applications: Emerging trends and issues'** underscored the potentials of geospatial applications in diverse areas, such as, energy security and sustainable development, food and water security, forestry, urban development, insurance, understanding of oceans and atmospherics and flood warning, among others. The range of geospatial applications depends upon high resolution data obtained from across the globe, necessitating collaborative approach (since geospatial data cannot be generated from one location).

Experts addressing the conference cited that real-time data obtained from geospatial applications contribute to real-time decision making in areas like agriculture (interventions in regard to which crop to sow and when); banking and insurance (assessment of credit-worthiness and assistance in loan recovery); infrastructure (identifying construction material demand and identifying land-use change); aviation (assisting airport authorities in managing air traffic) and so on. And given the high-resolution data that is needed, there is great scope for private sector participation in the space programme.

R&D is central to the advancement of space technology and applications. Throwing light on this in the session on **'Research collaborations and building technological capabilities for industry in Space'**, the deliberations in the space conference pointed to ISRO's pioneering role in building collaborations with industry in driving R&D in critical areas. Though government institution-driven research still forms a major chunk of space R&D in India, participation of private industry has been growing consistently in the area of space research. It may be added that Government of India has launched a number of initiatives, such as, Science & Technology clusters to attract local talent and the Finance Ministry has promised a Rs 50 crore fund to support R&D activities in the space sector.

The experts cited immense opportunities for industry in the space sector in the areas like Artificial Intelligence, data technologies, sensing technologies, and leveraging intellectual properties. From a hardware perspective, India needs more power-efficient systems and a lot of computing potential needs to be added at ground stations.

Throwing light on the new frontiers of space tech, it was stated that investing in space life-sciences promises to deliver key breakthroughs in the ability to live and work safely in space, treat medical conditions on earth, transform agricultural practices, and carefully consider the ethical dimensions of space explorations and settlements. Space life-sciences help in developing innovative treatments for people on earth, and pioneer new forms of medical products manufacturing including pharmaceuticals.

Curating the right business models is fundamental to industry's deep engagement in the space economy. In the session on **'Indian Space economy: Business models for enabling industry participation'**, the panelists stated that private players are poised to become 'co-travellers' in the space journey with ISRO, the experts pointed to the imperative for facilitating adequate financing of startups in the new space economy, and providing a level-playing field for all the stakeholders. The need for space laws and space insurance were among the other prerequisites highlighted in the discussions.

A robust ecosystem will drive the transforming of India's newspace economy. Experts addressing the session on **'Drivers for creating a robust space start-up ecosystem in India'** pointed out that as the demand for remote sensing applications, telecom services, navigational applications and other space-based applications continue to grow, India will increasingly experience capacity constraints in meeting this demand. Private participation in the sector will go a long way toward bridging these gaps.

Young entrepreneurs in the newspace economy stated that since 2019 there has been a dramatic shift in the venture capitalist (VC) outlook on space-based ventures, with a greater number of such ventures getting funded. VCs are now cognizant of the opportunity for these ventures to meet the global demand for space-based services. However, it is imperative to create a sustainable domestic demand for space technologies, applications and services, so that the startups are not entirely dependent on overseas markets for their growth. For that to happen, a robust domestic space ecosystem will have to be developed. It would also be advantageous to plug the global space ecosystem into the Indian space ecosystem. That would help the Indian space companies to scale up several fold.

In the session on **'Emerging trends in Satcom: An India specific perspective'**, the panelists cited that satellite communications, which is a $100 billion business globally, is a highly promising area for Indian industry. However, the satellite communication business requires huge capital investments, demonstration of capabilities and is called upon to handle challenges of obtaining regulatory clearances, licenses and authorisations and establishment of a user base.

Companies are looking at providing high throughput broadband connectivity through the Leo Constellation approach and eventually the emerging Leo Constellations like One Web and Starling will have global footprints. In this regard, Indian manufacturing and system integrator sector would have opportunities arising from hundreds of satellites in Leo Constellations that need to be launched and replenished regularly.

Highlighting the scope of global partnerships in the space economy, the discussants addressing the session on **'Increasing global partnership in Space sector: Explore as one'** cited that given the fact that only a handful of countries have launch capability, and with several countries aspiring to enter the space race, there are huge opportunities for India in capacity building initiatives.

In the **'Highlight Session: Human Spaceflight and Space Exploration Missions'** the experts stated that today India is at the forefront of both space exploration missions and human spaceflight programmes. Space exploration missions are pre-cursors to human spaceflights. In the realm of space exploration, ISRO has in recent years launched the Mars Orbitor Mission, Astrosat, Chandrayaan 1 & 2, and is undertaking Aditya L1 and SPOSAT missions.

Gaganyaan Project, which will be India's first human space mission, is now the fifth vertical of ISRO. The mission is planned to have 3 crew on board for the duration of 3-6 days. For this, the human rated launch vehicle has been developed. The programme that includes new frontiers like development of half-humanoids will also open up new vistas for human spaceflights,and calls for new development in areas like regeneration and recycling of resources, space waste management, development of inter-connected large structures in space, space farming, manufacturing in space, bioastronautics.

Human spaceflight missions are contributing to advancements in recycling, development of regenerative technology, waste management, among others. With robotics it would be possible for developing farming on other terrestrial bodies. Safety measures are accorded the highest priority in the case of manned space flights, and DRDO is engaged in the development of recovery vehicle, parachute system, simulation model for radiation, etc.

In the area of space tourism, India could take a lead in developing human-centric training mechanisms through multiple centres.

To move up the value chain, the experts addressing the conference pointed out that most private companies are engaged in build-to-spec or build-to-print activities, and extend design and manufacturing services. However, there is a need to promote product companies in this sector that are focused on R&D. Second, there is no structured platform where companies can interact with the academic or national space agencies. Third, most sub-systems are imported, and the suppliers are all too keen to dump them, whereas the importing companies would need access to larger sub-systems where those imported sub-systems can be tested and approved.

Among other key developments, they referred to accelerated digital transformation of the space sector, and adding strong computing capability to the missions and onboard spacecraft. **I**nitiatives are also underway to make the missions more cost-effective through efficient retrieval and reuse of different components of spacecraft.

Can India be the hub for Space manufacturing? Experts cited that a collaborative research culture has to emerge and technologies like 3D printing, friction stir welding, flow forming, AI Li alloys, composite manufacturing, and electronic device manufacturing capabilities need to be available in India. While institutions like ISRO, the presence of an established eco-system, recent reforms, downstream capabilities, and a maturing STEM sector represent India's strength, high cost of capital, and low-risk appetite of space companies represent the weaknesses that should be addressed swiftly.

There is also the need to promote semiconductor fab facilities, as currently the Indian space industry is mostly dependent on imported semiconductors.

The space economy touches human lives in a myriad ways. Space science and R&D have had a gamut of spinoffs for society like development of the heart pump, radial tyre, laser-based ophthalmic surgery, waste water recycling, air scrubbers for cleaning the environment, etc. Many of these innovations stem from the safety systems that are developed for the space missions.

The International Conference & Exhibition on Space 2021 was organised by the Confederation of Indian Industry (CII) in association with Antrix Corporation, Indian Space Research Organisation (ISRO) and New Space India Limited (NSIL).

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Address:	Mr Rajan Navani, Chairman, CII India@75 Council
	Dr D Radhakrishnan, Chairman and Managing Director, NewSpace India Limited (NSIL)
Special Address:	Dr Umamaheshwaran, Scientific Secretary, ISRO and In-charge (IN-SPACe activities)
	Mr Nico van Putten, Deputy Director, Netherland Space Office (NSO)
	Mr Anthony Murfett, Deputy Head, Australia Space Agency
	Dr Pawan Goenka, Chairman Designate, IN-SPACe
	Dr K Sivan, Chairman, ISRO and Secretary, Department of Space, Government of India
Vote of thanks:	Mr A Arunachalam, Director, NSIL

Key Assertions

Indian industry has a key role to play in the changing global Space landscape. Stating this in his Special Address, **Dr K Sivan, Chairman, ISRO and Secretary, Department of Space, Government of India** said industry including start-ups will have a gamut of new opportunities in areas like building and launching launch vehicles and satellites, developing satellite-based services and ground-level systems, undertaking R&D, and supporting mission services.

Highlighting the importance of cooperation and collaboration in the Indian space sector that has been significantly opened up by Government of India since 2020, Dr Sivan said that industry will be called upon to play a critical role in dealing with various issues like congestion in space, using scarce frequency, mobilisation and utilisation of technological and financial resources, among others.

Underlining the growing importance of space technology and applications in diverse streams, Dr Sivan said that wide-scale use of mobile applications and IoT, along with broadcasting and remote sensing activities have spurred the demand for space tech and applications, which are also needed for furthering sustainable development. He said the Department of Space is deeply committed towards ensuring a level playing field for industry, and said the Indian National Space and Authorization Center (IN-SPACe) will play a pioneering role in furthering the joint efforts of ISRO and Indian industry and start-ups to leverage the emerging commercial opportunities in the space sector.

Dr Sivan also underscored the new opportunities for foreign companies to invest in the Indian space sector. The FDI norms pertaining to the space sector are being reviewed by the Government, he said.

Dr Pawan Goenka, Chairman Designate, IN-SPACe, in his Special Address said that while India has been at the forefront of space technology, the country has less than 2% share of the global space industry that is estimated to be of the size of USD440 billion. Today, as the space sector opens up, several startups are coming up in the area, some of which, he said, could even go on to become unicorns.

Dr Goenka said that many of the startups appear to be focused on upstream activities, whereas there are greater commercial opportunities seen in the downstream activities of space technology and applications. He said that IN-SPACe will be focused upon providing greater policy and regulatory clarity to industry, promoting private investment opportunities, identifying new space technology applications, ensuring seamless coordination between the different space agencies, opening up overseas markets for domestic suppliers, facilitating cross-deployment of technologies, among others.

Dr Umamaheshwaran, Scientific Secretary, ISRO and Incharge (IN-SPACe activities), in his Special Address said that IN-SPACe will be playing a catalytic role in promoting, handholding, monitoring and authorising private players operating in the domestic space sector. He said that industry has submitted various proposals for upstream and downstream activities that are being reviewed and will be acted upon. The Space Bill is also under consideration. Looking ahead, he said that a thriving space sector is taking shape in India.

Mr Nico van Putten, Deputy Director, Netherland Space Office (NSO) in his Special Address said that the Netherlands and India are furthering bilateral cooperation for space technology application in areas like monitoring of air quality and climate, earth observation in the realms of water resources and agriculture, miniaturisation and development of nano satellites, and manufacturing of components and sub-systems.

Commending India for its milestone Gaganyaan programme, **Mr Anthony Murfett, Deputy Head, Australia Space Agency** in his Special Address said the agency is closely associated with the programme. He said there is immense scope for deep collaboration between Australian and Indian companies engaged in space technology and applications. He pointed out that the Australian Government is aiming to triple the size of its space industry from A$4 billion currently to A$12 billion by 2030. The global space industry size is expected to reach $1 trillion by 2040.

Dr D Radhakrishnan, Chairman and Managing Director, NewSpace India Limited (NSIL) in his address said that strong private sector participation in the space sector will bring about effective utilisation of the country's space infrastructure that is capital-intensive and has a long gestation period. Alluding to the space reforms undertaken by Government of India, he said the space missions are now moving towards a demand-driven model. That would also call for the investment opportunities to be made attractive for private players. He sees greater industrialisation across the space sector, including operating space launch vehicles. NSIL, he said, will play a major role in facilitating transfer of technology to the private sector.

Mr Rajan Navani, Chairman, CII India@75 Council said that CII is focused upon strengthening industry's collaboration with Government and international space agencies. India is primed to emerge as a major space manufacturing hub in the true spirt of an 'Atmanirbhar Bharat', he said. Mr Navani laid emphasis on the need for cluster development programmes that link the various space industry manufacturing companies. He also highlighted the imperative of promoting a robust space industry eco-system in the country.

Mr Rakesh Sasibhushan, Chairman, CII National Committee on Space, and CMD, Antrix Corporation Limited welcomed the dignitaries and participants in the conference. He said that foray of private companies in the commercial services segments of space will lend great vibrancy to the whole industry, which in turn will contribute significantly to the national GDP.

Mr A Arunachalam, Director, NSIL proposed the Vote of Thanks and concluded the session.

Key Recommendations

- Space missions are now moving towards a demand-driven model. That would also call for the investment opportunities to be made attractive for private players.

- Strong private sector participation in the space sector will bring about effective utilisation of the country's space infrastructure that is capital-intensive and has a long gestation period.

- Industry could play a critical role in dealing with issues like congestion in space, using scarce frequency, mobilisation and utilisation of technological and financial resources, among others.

- Start-ups could leverage new opportunities in areas like building and launching launch vehicles and satellites, developing satellite-based services and ground-level systems, undertaking R&D, and supporting mission services.

    - Startups may also be encouraged to pursue downstream activities of space technology and applications that have greater commercial opportunities.

- There is a strong need for cluster development programmes that link the various space industry manufacturing companies.

Session 1: Shaping future with Geospatial applications: Emerging trends and Issues

Session Chair:	Dr Rajkumar, Director, National remote Sensing Centre, ISRO
Panelists:	Dr Ish Mohan Bahuguna, Deputy Director, SAC, ISRO
	Mr Deven Laheru, President BD, Scanpoint Geomatics Ltd
	Mr Nikhil Kumar, President-Geospatial, Mapmyindia, Mapmyindia
	Ms Coco Antonissen,, Adviser, Earth Observation, Netherlands Space Office
	Mr Prateep Basu, Founder, SatSure
	Ms Mani Thiru, APJ Space Industry Development Leader Aerospace & Satellite Solutions, Amazon Web Services

Key Assertions

The session on the future of geospatial applications brought to the fore a gamut of uses of geospatial applications that are helping society. The session chair **Dr Rajkumar, Director, National Remote Sensing Centre, ISRO** set the tone for the deliberations by providing a glimpse of how these applications deliver social benefits -- in areas like energy security and sustainable development, agriculture, food and water security, forestry, fisheries, coastal ecosystems, urban development, insurance, understanding of oceans and atmospherics, climate change assessment including monitoring of rising sea levels and melting of glaciers, and flood warning and assessment of damage in extreme weather events, among others.

Government is also using geospatial data for its various schemes like Bima Yojana, Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Mahatma Gandhi National Rural Employment Generation Act (MGNREGA). The range of applications depends upon obtaining high resolution data from across the globe, necessitating a collaborative approach (since geospatial data cannot be generated from just one location).

While data is of critical importance to geospatial applications, Dr Rajkumar said that a whole ecosystem of information processing and analytics needs to be created. He referred to services created by ISRO like Bhuvan that provide imageries of satellite maps and images, and analysis, data downloads and reports, and Vedas, that has several applications for academia.

Dr Ish Mohan Bahuguna, Deputy Director, SAC, ISRO stated at the outset that in the 1990s itself ISRO, as part of a project called Integrated Mission for Sustainable Development, had engaged the private sector in several areas.

Dr Bahuguna described how the country's remote sensing activities that were in the test phase before year 2000, advanced to the development stage of geospatial technology in the last two decades (when new technology, new satellites and sensors and data emerged) to the operational stage now. However, Government alone would not be able to meet the growing manpower and infrastructure requirements of the newspace sector. The institutional capacity outside the government sphere would need to be reinforced.

Dr Bahuguna said that ISRO has demonstrated the efficacy of various technologies, and the private players would need to step in to build on the gains. To illustrate the need for an increased role of non-Government agencies in the sector, he cited the example of government's drive to restore 30 million hectares of degraded land by 2030. Where is the ground-level data for such policy decisions, he wondered. Those gaps shall be bridged with private sector participation.

Mr Deven Laheru, President BD, Scanpoint Geomatics Ltd reminded the gathering of the vision of Vikram Sarabhai, the father of India's space programme, to make space technology beneficial to society, and to make India self-reliant in various spheres using space technology. He said there never has been a better time to realise that vision than now.

Mr Laheru spoke of the changing paradigm of geospatial applications, enabled by the opening up of the sector. With the removal of entry barriers to private entrepreneurs and their expertise and knowledge being put to use, there is greater scope for innovations.

He cited availability of high-resolution real time data as another key development. Besides, amalgamation of technologies, such as, IoT and geospatial, creates new application value in many aspects of day-to-day living. Some of the applications cited were: efficient planning of travel and logistics; providing scientific inputs to farmers; better utilization of unused assets in rural areas; rescue operations in the event of natural calamities; planning for smart cities; and now COVID response.

What will the new space technology ecosystem of India look like, following the opening up of the sector to private players? A presentation by **Mr Prateep Basu, Founder, SatSure** provided a glimpse of that. An outfit started by the first batch of Indian Institute of Space Science and Technology, and manned by graduates from that institute, as well as experts from ISRO and NASA, and financial sector, the company is operating in 10 countries. SatSure has created a system that can ingest vast amounts of data, manage, analyse and disseminate that data in a simplified manner to end users.

Mr Basu referred to a vast range of applications that his company is working on – related to climate change mitigation (warnings regarding droughts and floods), emergency response services, agriculture (interventions like which crop to sow and when); banking and insurance (assessment of credit-worthiness, assistance in loan disbursement and loan recovery); infrastructure (identifying construction material demand and identifying changes in buildings and road use, and other land-use); aviation (assisting airport authorities in managing air traffic) and so on.

SatSure has filed for five patents. Mr Basu detailed some of the innovations that his company has introduced, like observation of soil moisture at 20 meters on a daily basis for 10 years and reconstructing images pixel by pixel, which helps in filling data gaps in case of cloudy conditions. The company is now planning for the launch of a remote sensing satellite to meet the growing demand for high-resolution data.

Mr Nikhil Kumar, **President - Geospatial, Mapmyindia** provided insights into the whole matrix of geospatial data and applications. He spoke about the hierarchy of users, starting from the creators of geospatial data and applications down to the end-users who are the beneficiaries, including governments and common users. From smart governance and response in crisis situations like COVID to cost-effective and energy-efficient functioning of industry to an alert and responsive citizenry, geo-spatial data and applications are

pervading every aspect of life. For larger use, the data needs to be democratised and made affordable, he said.

He also underscored the need for 'integrated, interoperable and transparent platforms' where real-time data can be ingested and analysed and disseminated to end users in a transparent manner.

Ms Coco Antonissen, Adviser, Earth Observation, Netherlands Space Office provided insights into the use of open and commercial data that her organisation manages; and how they helps businesses in innovations with use of that data.

Ms Mani Thiru, APJ Space Industry Development Leader Aerospace & Satellite Solutions, Amazon Web Services acknowledged that space is now crucial to national security and economic prosperity and delved into how her organisation is making data intelligible to the end user. Startups coming into the sector and the democratisation of data for spurring innovation would prove beneficial for the sector, she added.

The use of data for societal benefits, and use of space technology for sustainability was the focus of her presentation. She said nothing is impossible today, what with the increased frequency of satellites in the sky and high-resolution data that is being generated. So, when a disaster strikes, emergency response is possible. She gave the example of Fireball International in Australia, which is able to alert authorities within three minutes of a bushfire or wildfire, enabling speedy evacuation of citizens and livestock..

Detailing the Amazon Web Services' activities, she informed that a team with combined experience of over 400 years is involved in design, building and launch of satellites, to running eight ground stations across the globe.

<u>Key Recommendations</u>

- While data is of critical importance to geospatial applications, an ecosystem for information processing and analytics needs to be created.

- Government alone would not be able to meet the growing manpower and infrastructure requirements of the newspace sector. Industry could play a key role in institutional capacity building outside the government sphere.
    - ISRO has demonstrated the efficacy of various technologies, and the private players would need to step in to build on the gains.

- From smart governance and response in crisis situations like COVID to cost-effective and energy-efficient functioning of industry to an alert and responsive citizenry, geo-spatial data and applications are pervading every aspect of life. For larger use, the data needs to be democratised and made affordable.

- Develop integrated, interoperable and transparent platforms where real-time data can be ingested and analysed and disseminated to end users in a transparent manner.

Session 2: Research collaborations and building technological capabilities for industry in Space

Session Chair:	Mr N Sudheer Kumar, Director, CBPO, ISRO HQ
Panelists:	Mr Balamuralidhar, Chief Scientist, TCS Research
	Dr Ashwini Ratnoo, Associate Prof. IISC, Bangalore
	Mr Joji J Chaman, Deputy Director, IISU, ISRO
	Mr G Ayyappan, Chief Technology Officer, IIST
	Mr Gurvinder Singh, Head, SCL, ISRO
	Mr Dinesh Kumar Singh, Deputy Director, SAC, ISRO
	Dr Tirtha Pratim Das, Director, DTDI
	Prof. Virginia Kilborn, Chief Scientist Swinburne University, Australia
	Prof. Alfred Stein, ITC Twente
	Prof. Andy Koronios, PhD, Chief Executive Officer & Managing Director, SmartSat Cooperative Research Centre, Australia

Key Assertions

Mr N Sudheer Kumar, Director, CBPO, ISRO HQ, in his opening remarks said the main mandate of ISRO is R&D which has been playing a significant role in the sector's growth. Collaborations and building technology capabilities for the industry will be the buzzwords in near future, he said.

Speaking about India's spends on R&D, he said the country's GDP is growing at 7% and the R&D expenditure is also growing consistently at 8.7%. However, the immediate short-term target would be to take it 2% higher. Though government institution-driven research still forms a major chunk of R&D in India, participation of private industry has been growing consistently in the area of space research, he added.

Participation of private sector in R&D should be encouraged, he said, adding that the emphasis of government-led scientific technology strategy groups is to encourage private enterprises to take the lead in development of different technologies. Hence, Government's expectation is to leverage research in all S&T organizations.
Government has launched a number of initiatives such as Science & Technology clusters to attract local talent, and recently the Finance Minister has promised a Rs 50 crore fund to support internationally important R&D projects in the space sector, said Mr Kumar.

Some of the prestigious projects being planned by ISRO include the Gaganyaan Mission, Mark3 launch vehicle, reusable launch vehicle, TSTO, HLV variants, satellite sub-systems like deployable antennas, TWTAs, deployable solar panels, etc. He said there is also demand to establish facilities for technologies like composite fibre to support their production in India. Also, several platforms have been conceived like three regional academia centres, space technology centres, and space technology incubation centres to carry out collaborative R&D projects with different premier institutions across the country.

Mr Kumar pointed out that ISRO's capabilities are centred in four core areas: space transportation, space infrastructure, capacity building and space applications. He said that the small satellite segment has come up in the past few decades and the technology is converging into next phase of Gaganyaan.

Mr Kumar said that technology transfer and indigenisation of space elements are important aspects of achieving the goal of "Atmanirbhar Bharat", adding that ISRO is closely working with industry to transfer technologies for indigenisation. He pointed out that as far as material and mechanical systems are concerned, India is self-reliant to the extent of 95-98%, whereas, on the electronics front, the country depends on foreign sources to the extent of more than 50% of the domestic needs.

Mr Balamuralidhar, Chief Scientist, TCS Research said there are immense opportunities for industry in the space sector in areas like Artificial Intelligence, data technologies, sensing technologies, and leveraging intellectual properties. From a hardware perspective, India needs more power-efficient systems and a lot of computing potential needs to be added at ground stations. There are also opportunities for industry in space robotics, he added.

Highlighting other areas of opportunities for industry, he said there is demand for events from the observation satellite perspective, such as, for high resolution and 3D perception and the need to design and distinguish between materials and components. Speaking on demand from the systems dynamics perspective, Mr Balamuralidhar said there is a need to enable satellite systems through advanced known constellations in Swan technologies. Also, there is an opportunity in providing computing operations and using multiple data sources within multiple sensing technologies, which basically contribute towards different aspects of the VDF systems, and then eventually increasing the resolution of that data.

Speaking from the hardware perspective, he said the onboard computing requires orbital edge computing, and therefore, there is a need to have much more power efficient systems. Highlighting opportunities in space robotics, he said that given the number of satellites in space there is a need for debris removal and debris handling through new technologies.

Dr Ashwini Ratnoo, Associate Prof. IISC, Bangalore shared some success stories of academia-industry collaborations. He highlighted some areas where efforts have been made from the academia side for the development of technologies like computational fluid dynamics implemented by satellites, artificial intelligence and machine learning.

Dr Ratnoo said that academic research is essentially built on pillars like sound ideas, rigorous testing and peer review. However, co-creation happens when industry joins the efforts. He pointed out that academia could play a major role in space R&D by leveraging subject expertise through consultancy and sponsored research. Aggressive management of space R&D requires young experts, and India's fresh PhD graduates could make much difference in this regard, he said.

Giving an overview of IISC Bangalore's Space Technology Cell, he added that it supports a wide range of activities across various disciplines. Till date, the cell has completed close to 470 projects, covering a wide range of topics like ceramics, deployment structures, photo detectors, hypersonic combustion, etc.

Mr Joji J Chaman, Deputy Director, IISU, ISRO said the yardstick of a successful project should be the usefulness of the end product. He cited cases of research collaborations with DEFT for VBA.

Mr G Ayyappan, Chief Technology Officer, IIST touched upon the ways to build technological capability in industry. He said that each space industry segment should look to become an ISRO centre. Citing his interaction with academia, academic institutes as well as industries, he said that most industries were concentrating on their manufacturing processes, and now they would want to become end-to-end facilities for service technology, realisation of launch vehicle from the conceptual design, configuration design, and system engineering, to manufacturing, assembly, integration, etc.

However, it requires creating skilled workforce as well as advancing research and knowledge, which is not a simple task and requires continuous effort in a dedicated manner. As there is no room for failure, he suggested that ISRO should aim to build end-to-end capacity among industry players and a greater number of research papers needs to come out based on industry-driven projects.

Mr Ayyappan said that academia-industry partnership already exists in many forms like study programmes or curriculum advisory boards or lectureship, etc, but what is needed is a focused approach in identifying groups and opportunities for growth. He suggested that industry should take part in the process of gathering more theoretical knowledge, adding that sponsored post-graduate programmes like the ones started by Larsen & Toubro could help in creating industry-ready space R&D professionals.

Mr Gurvinder Singh, Head, SCL, ISRO said that SCL has an integrated device manufacturing capabilities in micro-electronics for space and they have collaborated with 70 institutes, including IITs, for research, design and development process of devices.

Dr Dinesh Kumar Singh, Deputy Director, SAC, ISRO said the space industry in India is passing through a defining phase and a rapid transformation from a part-time subsystem production partner to a complete solution provider and system developer. This would call for various multidisciplinary technologies to be developed by industry. He underlined the need for enhanced focus on: availability of hi-tech infrastructure, human resource and skillsets; collaboration and synergy with other sectors in the area of new technology; clarity on the economic viability of projects; and early entry into emerging technologies like free space optical communication.

He suggested that to develop high-tech infrastructure, which is capital intensive, there has to be a proper mechanism for incentives to be given for making investments. Dr Singh also said that despite government-funded infrastructure, there can be a generic common resource pool that can be centrally-created and maintained for industry on a need basis.

Dr Singh suggested that a common platform, which has its own commercial model, could be developed to pool skilled human resources for the space sector in areas like core R&D for technology, systems engineering, systems integration, supply chain, etc.

Dr Tirtha Pratim Das, Director, Directorate of Technology Development & Innovation (DTDI), ISRO said the future lies in integrating the right amount of conventional technologies with unconventional thinking, to achieve excellence in space technology. That would call for collaborations between institutes, industry and academic. DTDI was constituted in 2018 to equip ISRO with futuristic technologies for the next 4-5 decades of development. The major areas of disruptive technologies cited were: quantum technologies, space robotics, energy security, AI-based solutions, technology for space debris management, and planetary exploration.

Prof. Virginia Kilborn, Chief Scientist Swinburne University, Australia in her address touched upon two areas: 1) space lifesciences, and 2) building a diverse space workforce with greater participation of women. She said that investing in space lifesciences promises to deliver key breakthroughs in the ability to live and work safely in space, treat medical conditions on earth, transform agricultural practices, and carefully consider the ethical dimensions of space explorations and settlements.

Prof. Kilborn added that space lifesciences help in developing innovative treatments for people on earth, and pioneer new forms of medical products manufacturing including pharmaceuticals.

Space lifesciences is being recognised as a key area of technology development with many governments investing in these areas. Incentives are also being provided to private players to invest in these areas, she said. Space lifesciences has the potential for developing innovative treatments for cardio-vascular diseases and lung conditions, neurological conditions, visual and other sensory problems. Experiments in growing human tissues in space have also potential application in organ transplants, said Prof. Kilborn.

One of the potential areas of collaboration is in flight capacity across the entire spectrum of micro-gravity flights including parabolic, sub-orbital, orbital and sounding rockets. There is also scope for collaboration in advanced manufacturing, particularly of micro platform design. In regard to workforce development, Australia will be adding 20,000 jobs in this area in the next 10 years. She advocated inter-country exchange programmes for professionals to fill the knowledge gaps. Also, women need to be encouraged to take up STEM education at an early age, she stated emphatically.

Prof. Alfred Stein, ITC Twente, said the collaboration with Indian Institute of Remote Sensing (IIRS) has been in existence for over 50 years. Referring to the Eramus Plus project BReUCom that is focused on mitigating climate change and the impacts on urban settlements, he said that in the collaboration with Indian institutions, there is scaling up of strategic relationships in applications in agriculture, animal husbandry and dairy sectors.

Key Recommendations

- There are immense opportunities for industry in the space sector in areas like Artificial Intelligence, data technologies, sensing technologies, and leveraging intellectual properties. From a hardware perspective, India needs more power-efficient systems and a lot of computing potential needs to be added at ground stations. There are also opportunities for industry in space robotics.

- Participation of the private sector in R&D should be encouraged.

    - Government-led scientific technology strategy groups are oriented to encourage private enterprises to take the lead in the development of different technologies.

- Technology transfer and indigenisation of space elements are key to achieving the goal of creating an "Atmanirbhar Bharat" in the space sector. India need to reduce the depends on the electronics front in the space sector.

- Enable satellite systems through advanced known constellations in Swan technologies. There is an opportunity in providing computing operations and using multiple data sources within multiple sensing technologies, which basically contribute to different aspects of the VDF systems, and then eventually increasing the resolution of that data.

- Onboard computing requires orbital edge computing, and there is a need to have much more power efficient systems.

- In regard to space robotics, given the number of satellites in space, there is a need for debris removal and debris handling through use of new technologies.

- Academia could play a major role in space R&D by leveraging subject expertise through consultancy and sponsored research.

- ISRO should aim to build end-to-end capacity among industry players and a greater number of research papers needs to come out of industry-driven projects.

- Create a pool of skilled human resources in areas like core R&D for technology, systems engineering, systems integration, supply chain, etc.

- Investing in space life sciences promises to deliver key breakthroughs in the ability to live and work safely in space, treat medical conditions on earth, transform agricultural practices, and carefully consider the ethical dimensions of space explorations and settlements.
    - Space life sciences also have the potential for developing innovative treatments for cardio-vascular diseases and lung conditions, neurological conditions, visual and other sensory problems. Experiments in growing human tissues in space have also potential application in organ transplants.
- Women need to be encouraged to take up STEM education at an early age, she stated emphatically.

Day 2: September 14

Session 1: Indian Space economy: Business models for enabling industry participation

Session Chair:	Mr Rakesh Sasibhushan, Chairman, CII National Space Committee and CMD, Antrix Corporation Limited
Panelists:	Dr Subba Rao Pavuluri, CMD, Ananth Technologies
	Mr M K Mishra, General Manager (ASD), Hindustan Aeronautics Ltd.
	Mr D Krishna Gopal, Senior VP, AlphaDesign Technologies
	Mr Srinath Ravichandran, Co-Founder & CEO, AgniKul Cosmos
	Mr Naga Bharath Daka, Co-Founder & COO, Skyroot Aerospace
	Mr Shaunak Shah, Director, Komoline Aerospace

Key Assertions

Speakers addressing this session commended Government for the policy reforms that lead to private participation in the space sector. **Mr Rakesh Sasibhushan**, **Chairman, CII National Space Committee and CMD, Antrix Corporation Limited**, who chaired the session, said in his opening remarks that the Indian space sector was earlier a highly restricted domain, and so unlike any other space-faring nation, the sector had faced capacity constraints.

Highlighting the need for a robust space ecosystem for defence as well as civilian needs, he said that Government has now created a level-playing field for private companies, a predictable policy and regulatory environment and ISRO facilities could be accessed by private players. The reforms will make the sector demand-driven as opposed to the erstwhile supply-driven model, and that will also step up commercial activities. However, enterprises entering the newspace economy do face challenges seen in regard to funding and access to technology. He called for seamless sharing of technologies with the private players in the sector.

Dr Subba Rao Pavuluri, CMD, Ananth Technologies took a plunge into the sector in 1993 as he sensed a raft of of opportunities in this area, both in the technology and commercial spheres. Over the years, the company has contributed to 88 satellites launches by ISRO and development of 67 launch vehicles.

Dr Pavuluri said the opening up the space sector encourages private companies to become 'co-travelers' in ISRO’s onward journey. However, that necessitates the creation of a level-playing field for the private players. While the dominant players in the sector may not help the cause of creating a level-playing field, he said that Chairman designate of Indian National Space Promotion Authorization Centre, Dr Pawan Goenka's has assured industry of creating an enabling environment for private participation.

Dr Pavuluri said the private participation in the sector is also hampered by lack of adequate funding of businesses. However, the opening up of the sector to 100% FDI in the near future will provide the necessary impetus to the sector’s all-round expansion. New space laws and insurance innovations were among the other prerequisites for the sector that he highlighted.

On the opportunities side, he said space is global in nature, and Indian players could look to play a greater role in the global space-related businesses. India could also become a manufacturing hub for satellites, he said. Also, given the geopolitical situation in India's neighbourhood, surveillance will become a high priority.

Dr Pavuluri asserted the need for industry-wide understanding of the space economy. Space technology without an understanding of the space economy would not amount to much. He concluded by saying that globally, economies will gravitate towards space.

Mr M K Mishra, **General Manager (ASD), Hindustan Aeronautics Ltd** said the reforms introduced by Government in the space sector will help boost innovation and entrepreneurship and bolster indigenous technology development, powered by Government's *Atmanirbhar Bharat* initiative.

Currently, India's space economy accounts for just 2-3% of the global space economy share. As Government sets sights on achieving $5 trillion GDP target by 2024, and manufacturing share of GDP to 25% by 2025, the opportunities in the space sector will grow exponentially. India's space sector will thus enhance its share of the global space economy.

Requirement of space-based applications has increased manifold. But for the sector to grow, strong commercial space ecosystem is needed, across the value chain – covering manufacturing, satellite operations, downstream applications, etc. Rather than competition, the sector should adopt the approach of cooperation and collaboration, and go for technology sharing, said Mr Mishra. Futuristic technology development ought to be a continuous effort, he said, while adding that for India to become a manufacturing hub in the space sector, the industry would have to offer end-to-end solutions, from design to the final product.

Some of the challenges that he pointed out were in regard to technology upgradation, capacity building and cost competitiveness. Currently, the industry, in association with ISRO, have acquired the required skills sets. He suggested initial hand-holding by ISRO for new players in the form of providing designs and drawings, till a point when these start-ups become mature enough to build products on their own.

He assured the gathering that HAL, with more than five decades of partnership with ISRO, and with proven manufacturing excellence in the space sector, will continue to contribute toward creating a healthy space manufacturing ecosystem.

Representing the growing presence of young entrepreneurs in the space ecosystem in India, **Mr Srinath Ravichandran, Co-Founder & CEO, AgniKul Cosmos** voiced the optimism and fresh perspective of new entrants in this field. He said that even before the reforms were brought about, their outfit had entered this field as a 'leap of faith', as students hungry to do more. Because they were associated with IIT Madras, they tapped the expertise of the academia and students eager to explore the sector.

Educational institutions could play a much larger role in raising new startups, he said. They also invited experts who have retired from ISRO to play a catalytic role in developing the startups. He said existing expertise can be made better use of and there is no need to reinvent the wheel.

Mr Ravichandran said that the outlook of funding agencies like VCs on space-related business has changed, and that investors now have the appetite now to fund space-related ventures. It's the responsibility of startups to deliver on the promise.

Mr Naga Bharath Daka, Co-Founder & COO, Skyroot Aerospace, expressed similar optimism of startups succeeding in the space sector. He said that with policy direction in place as regards private sector, investors will be comfortable in funding private sector projects. He appreciated Dr Pawan Goenka's thoughts on setting key performance indicators to increase India's market share in the space business.

Mr Shaunak Shah, **Director, Komoline Aerospace** described how his Ahmedabad-based company has been supporting the Space Application Centre and participating in many missions of ISRO, supplying local sub systems. He said that now, with new entrants entering the field, the company plans to cater to existing as well as new players and there is the need to recalibrate existing systems and augment existing capacity to meet future needs.

The participants were in agreement regarding demand-driven growth of space sector as a much-needed shift, though Dr Pavuluri pointed out that such demand existed earlier too. What is needed is an enabling ecosystem around that demand, which has been created post-liberalisation.

Mr Ravichandran said that a demand-driven market is good for the sector, and that innovative solutions being proposed through launch of small satellites. Mr Daka said there is a lot of latent demand which doesn't come to the fore when it's supply-side restricted industry. In the changed scenario, Government could also use private launch vehicles in the future.

Mr Shah said that the demand will create pressures of time and cost effectiveness, and other global players might be in a better position to meet that demand, with off-the-shelf products.

Mr D Krishna Gopal, **Senior VP, AlphaDesign Technologies** voiced the demand of the industry for a realistic assessment of the market in the form of a report or a White Paper. There will have to be sufficient clarity on allocation of space segment and bandwidth, he said.

Key Recommendations

- For the Space sector to grow, a strong commercial space ecosystem is needed, across the value chain – covering manufacturing, satellite operations, downstream applications, etc.
    - Rather than competition, the sector should adopt the approach of cooperation and collaboration, and go for technology sharing.
- Develop a robust space ecosystem for defence as well as civilian needs and create a level-playing field for private players.
    - Promote seamless sharing of technologies.
- New space laws and insurance innovations are among the prerequisites for the space sector's future growth.
- Indian players could look to play a greater role in the global space-related businesses.
- India could also become a manufacturing hub for satellites.
- Given the geopolitical situation in India's neighbourhood, surveillance will become a high priority for Government and industry.

Session 2: Drivers for creating a robust start-up ecosystem in India

Session Chair: Ambassador Rakesh Sood, Former civil servant belonging to the Indian Foreign Service, Columnist, and Writer

Panelists: Mr Rohan M Ganapathy, CEO & CTO, Bellatrix Aerospace

Mr Abhinav Anuket, Founder and CEO, Starburst Aerospace, India

Dr Jayakumar Venkatesan, CEO, Valles Marineris International

Mr Chintan Vaishnav, Mission Director, Atal Innovation Mission

Mr N Sudheer Kumar, Director, CBPO, ISRO HQ

Mr Kumar Singarajah, Director, Government & Regulatory Affairs (UK & Europe), Astroscale

Key Assertions

As the demand for remote sensing applications, telecom services, navigational applications and other space-based applications continue to grow, India will increasingly experience capacity constraints in meeting this demand. The domestic space sector has now been opened up, and that will encourage private players to enter the fray and help meet the exploding demand for space-based services. Stating this in his opening remarks, **Ambassador Rakesh Sood, Former civil servant belonging to the Indian Foreign Service, Columnist, and Writer** said there is a great need for deep engagement between ISRO and NSIL and the private sector. He also expressed hope that a new draft Space Law will come into effect in the near future that supports the industry's onward growth journey.

Mr Rohan M Ganapathy, CEO & CTO, Bellatrix Aerospace said that since 2019 there has been a dramatic shift in the venture capitalist (VC) outlook on space-based ventures, with a greater number of such ventures getting funded. VCs are now cognizant of the opportunity for these ventures to meet the global demand for space-based services. However, he said that it is imperative to create a sustainable domestic demand for space technologies, applications and services, so that the startups are not entirely dependent on overseas markets for their growth. For that to happen, a robust domestic space ecosystem will have to be developed.

Mr Abhinav Anuket, Founder and CEO, Starburst Aerospace, India said even as steps are being initiated to build a strong domestic space ecosystem, it would be advantageous to plug the global space ecosystem into the Indian space ecosystem. That would help the Indian space companies to scale up several fold.

Dr Jayakumar Venkatesan, CEO, Valles Marineris International cited the Gaganyaan programme as a major catalyst for the sector's transformation, and an avenue for providing key opportunities to ventures such as Valles Marineris International.

Mr Chintan Vaishnav, Mission Director, Atal Innovation Mission cited that building the necessary infrastructure is vital to building an ecosystem for innovation. Atal Innovation Mission also focuses upon promoting innovations that serve national interest. Ideas for space sector have come up in this regard, he said. It is imperative to build and strengthen the pipeline for space projects, and also speed up the initiatives in regard to space innovation.

Mr N Sudheer Kumar, Director, CBPO, ISRO HQ stated that ISRO had been supporting private players since the 1970s. Today, as the demand for space-based services and applications grow, there is ample scope for private players to establish themselves in the space sector. As facilities are being made available to the private sector, Indian industry should step forward to leverage the new opportunities, he said.

Mr Sood pointed out that in the past when ISRO worked with large corporates in space-related areas, those entities had the capacity to work in this sector without being constrained by the limited profits and long gestation periods as they had larger businesses to bank upon. However, when it comes to startups working in the space sector, the support system required for them would be of a different order.

Mr Kumar Singarajah, Director, Government & Regulatory Affairs (UK & Europe), Astroscale said that India could leverage its core strengths, viz, ISRO, a large pool of entrepreneurs, strong engineering and business capabilities, access to capital, and a large national GDP, to gain a much larger share of the global space industry. Citing that the UK had some time ago set a target of gaining some 10% share of the global space industry, he said that India could exceed that level by undertaking key steps. Some of the steps that he recommended were: 1) consistent government policy supportive of space industry growth, competitiveness, and national strategic goals, 2) enabling legal, regulatory and financial systems – including for SMEs, 3) innovation funding by Central and state government agencies, 4) innovation hubs / centres of excellence, and 5) enable / support FDI and international partnerships.

In the Q&A session, Mr Sudheer pointed out that while governments are major users of space applications and services, it is necessary to engage the district magistrates in procuring the space applications and services for use at the grassroot level. Policies need to be fine-tuned to bring about this change, he said.

Mr Vaishnav said it also necessary to ensure that the space services are employed for the betterment of the lives of people like farmers and others at the grassroot level.

Key Recommendations

- There is a strong felt need for deep engagement between ISRO and NSIL and the private sector.
- It is imperative to create a sustainable domestic demand for space technologies, applications and services, so that the startups are not entirely dependent on overseas markets for their growth.
- Take the initiative to connect the Indian space ecosystem with the global space ecosystem.
    - That would help the Indian space companies to scale up several fold.
- Build and strengthen the pipeline for space projects, and speed up the initiatives in regard to space innovation.
- Create a consistent government policy supportive of space industry growth, competitiveness, and national strategic goals
- Build legal, regulatory and financial systems for Space-related businesses.
- Ensure innovation funding by Central and state government agencies.
- Promote innovation hubs / centres of excellence.
- Enable / support FDI and international partnerships.

Session 3: Can India be the hub for Space manufacturing?

Session Chair: Dr P V Venkitakrishnan, Satish Dhawan Prof, ISRO

Panelists: Mr Sathyan Subbiah, Coordinator, Extra Terrestrial Manufacturing Research Group, IIT Madras

Mr Laxmesh BH , Head – Missiles & Aerospace Business, Larsen & Toubro

Mr M V Reddy, JMD , Astra Microwave Products Ltd

Mr Tom Segret, CEO, Azista BST Aerospace

Mr K Soundhar Rajhan, Director – Operations, Lakshmi Machine Works Ltd.

Mr Dhiraj Keskar, Walchandnagar Industries Limited

Mr Vinod Chippalkatti, President, Strategic Electronics BU, Centum Group

Mr S Rangarajan, CMD, Data Patterns

Mr Bert Monna, CEO, Hyperion Technologies

Key Assertions

Touching upon various aspects of the space manufacturing industry, experts participating in this session were unanimous in their opinion that India has the potential to become a global hub for space manufacturing, as they analysed the strengths, weaknesses, opportunities, and challenges the country faces when it comes to increasing its share in the global space industry.

Dr P V Venkitakrishnan, Satish Dhawan Prof, ISRO, set the context for the discussion by saying that in the past couple of years India has initiated several reforms in the space sector for it become more competitive and lucrative for investors. However, collaborative funding by all stakeholders is necessary for the space sector to reach its full potential.

Dr Venkitakrishnan added that a collaborative research culture has to emerge within the space sector where currently IPRs are easily shared. Technologies like 3D printing, friction stir welding, flow forming, Al Li alloys, composite manufacturing, and electronic device manufacturing capabilities need to be made available in India, he said, adding that there is a need to categorise what ought to be Indianised on priority so that India could avoid reinventing the wheel and instead leapfrog into the future of space industry.

He also pointed out that India would not be able to reap the benefits of FDI in the space sector until it is able to develop the domestic markets. He urged Government to orient the policy toward facilitating changes like providing funding to acquire high-end and futuristic equipment under the banner of ISRO to be shared with industry under IN-SPACEe. He also suggested that GOCO models must be encouraged apart from offering tax holidays to investors and making more venture capital available to startups.

Mr Sathyan Subbiah, Coordinator, Extra Terrestrial Manufacturing Research Group, IIT Madras suggested that a risk-taking culture needs to be promoted in the Indian space sector and there are a lot of opportunities in space manufacturing. He suggested setting up low earth orbit factories where things could be made in space for space use, and also for bringing it back to the earth.

He added that creating settlements in faraway locations will happen in the near future. As there's extensive time to be spent on onboard a spacecraft or space station, that time could be utilised to create interesting products by tailoring material structures in microgravity, he said.

Mr Subbiah said that his research group is working on ideas influenced by limited space, limited power, microgravity influence, and recycling of byproducts required onboard a spacecraft or space station.

Mr Laxmesh B H, Head – Missiles & Aerospace Business, Larsen & Toubro said that based on activities, the space sector can be divided into 'space for earth' and 'space for space'. He added that the space sector is emerging as the 4th global economic frontier, but India still holds only 2-3% of the global space market. Presenting a SWOT analysis of India's space sector, Mr Laxmesh pointed out that while institutions like ISRO, presence of an established ecosystem, recent reforms, downstream capabilities, and a maturing

STEM sector represent India's strength, high cost of capital, and low-risk appetite of space companies represent the weaknesses that should be addressed swiftly.

He suggested that stakeholders across the value chain should come together in an internal collaborative manner, and address solutions for both internal and external customers. Also, Government should provide incentives for investments in space R&D and introduce an Indian space quality system.

Mr M V Reddy, JMD, Astra Microwave Products Ltd said that India's space programme is one of the largest in the world and to boost space manufacturing, robust infrastructure is being created. He added that ISRO has helped create a strong ecosystem and investments are being made in skilled human resources that has resulted in the availability of 12,000 strong skilled manpower in the space sector, and a cumulative investment of Rs 2000 crore.

He suggested that government policies need to be put in place to promote manufacturing of semiconductor fab facilities, as currently, the Indian space industry is mostly dependent on imported semiconductors. Mr Reddy said that development of more industries to fulfil the need for specialised processes, facilitating JVs in the space sector, switching from a supply chain-driven model to a demand-driven model, and enhanced approvals for ground stations would go a long way in supporting the sector.

Mr Tom Segret, CEO, Azista BST Aerospace said that India requires a page or two from the books of other nations as the success of Indian space manufacturing would depend on demand from the local market, which will also ensure the emergence of new space brands from India.

Mr K Soundhar Rajhan, Director – Operations, Lakshmi Machine Works Ltd said that the space value chain offers ample opportunity to industry as there is demand for

manufacturing spacecraft, payloads, launch vehicles and other systems to be used in space. However, he pointed out that major independent development of space systems has not happened outside ISRO due to limited volumes, high risks, lack of specialised manpower, and limited access to global market.

Mr Rajhan added that as far as ISRO is concerned, it has built capabilities and now sharing facilities until the private industries come up with such facilities on their own. It is a positive change, he said, as it will go a long way to support private investors in their growth. He also added that startups that are coming up in space sector need to be encouraged through initiatives like setting up technology development funds to boost ground station infrastructure development, engineering and services for space applications.

Mr Dhiraj Keskar, Head (Aerospace & Missiles), Walchandnagar Industries Limited said that a lot of groundwork has already been completed and sustained push is being given to help the Indian space sector expand. He suggested that India is ready to take up opportunities in the space sector, but there is a need to develop some kind of mechanism to support tier-1 and tier-2 companies with capital.

Mr Vinod Chippalkatti, President, Strategic Electronics BU, Centum Group pointed out that most of the Indian space industry's contributions are at the Modules and Subsystem level and not at the System level. He said that going forward, the Indian space industry will continue to work with ISRO on scientific and technological missions, build technologies, and engage with a wider scope of work. However, there are transition challenges and expectations as before the reforms ISRO plans would automatically translate into industry plans but now there is lack of clarity on ISRO's plans for communication and other sectors and there is a paradigm shift happening from traditional space to 'New Space'.

He also suggested that using the last two to three decades of learning, the Indian space sector should explore and prepare to work on the space-based programmes for the defence sector. And most importantly, the industry should create partnerships with global space industries and work on global opportunities, he added.

Another important suggestion he made was that the Indian space sector is transitioning since 2020, which is a step change, and this change is something which should be smooth.

Mr Chippalkatti pointed out that there is a need for moving up the value chain from a subsystem player to a system player, which is possible only with collaborations and partnerships through a consortia approach with the Indian and global players.

Mr Bert Monna, CEO, Hyperion Technologies said that India's population is young and ambitious, and therefore, the space industry in India should not limit its goals to only become a manufacturing hub. He suggested that the Indian space industry should think bigger by trying to figure out what else it could contribute toward the betterment of the world.

Key Recommendations

- A collaborative research culture has to emerge within the space sector. Technologies like 3D printing, friction stir welding, flow forming, AI Li alloys, composite manufacturing, and electronic device manufacturing capabilities need to be made available to the businesses.
- Government may help facilitate funding for acquiring high-end and futuristic equipment under the banner of ISRO to be shared with industry under IN-SPACEe.
- The GOCO models must be encouraged, apart from offering tax holidays to investors and making more venture capital available to startups.
- A risk-taking culture needs to be promoted in the Indian space sector.
- Set up low earth orbit factories where things could be made in space for space use.
- Create products by tailoring material structures in microgravity.
- The space sector can be divided into 'space for earth' and 'space for space'.
- Stakeholders across the value chain should come together in an internal collaborative manner, and address solutions for both internal and external customers.
- Government should provide incentives for investments in space R&D and introduce an Indian space quality system.
- Government should look to promote semiconductor fab facilities, as currently the Indian space industry is mostly dependent on imported semiconductors.

Day 3: September 15

Session 1: Increasing global partnership in space sector: Explore as one

Session Chair: Mr S Somanath, Director, VSSC

Panelists: Mr M Sankaran, Director, URSC

Mr Narayan Prasad, COO, Satsearch.co NL

Mr Shaju Stephen, Chairman and Managing Director, Aadyah Aerospace

Mr Nitish K Singh Co-founder & CEO, Astrogate Labs

Ms Guler Kocak, Founder & CEO, SPACELIS

Mr James Palmer, Founder, Space Centre Australia

Mr Arfan Chaudhry, International Director, UK Space Agency

Mr Artur Jutman, Managing Director, Testonica Lab, Estonia

Mr C J Fong, National Space Organisation, Taiwan

Key Assertions

The session on global partnerships brought to light multiple dimensions of global cooperation -- from intergovernmental dialogue to commercial agreements and regulatory and enabling environment for startups.

Chairing the session, **Mr S Somanath, Director, Vikram Sarabhai Space Centre** said that global partnerships are seldom one-dimensional and that they require different styles of engagement with different partners. The partnerships would have to be mutually beneficial to the partnering countries or companies. A new space ecosystem with a robust regulatory framework needs to be established. He also underlined that India should look to support countries that have not developed space capability, through training programmes, etc.

Mr M Sankaran, Director, UR Rao Satellite Centre cited how India's space journey and the space programmes of ISRO have been enriched by international cooperation down the decades, and how international cooperation in the future too can bring benefits to people's doorsteps. He gave the example of the Unnati programme for training people in developing small satellites. He laid emphasis on taking the benefits of space technology to those countries that are still not in the space race, through tele-medicine, tele-education etc. Given the financial constraints of various space agencies, they should look to collaborate with each other for the benefit of humanity, he said.

Mr Narayan Prasad, **COO, Satsearch.co NL**, referred to a study on the status of space industry supply chain conducted about a year ago that mapped 300 companies involved in supplying to ISRO for various missions. A key finding was that most of those companies lacked adequate exposure to international markets.

Earlier, procurement was done locally by space industries or defence agencies and contractors. But today, with the rise of commercial space, supply chains are getting globalised. India would do well to ensure supply chain transparency, he said, while adding that American and European space engineers are in general unaware of Indian suppliers except for ISRO and Antrix. There is a need to have Indian products and services highlighted on a common platform, the way European Space Agency launched ESA Start – that helps European suppliers to broadcast their capabilities, products and services.

Mr Shaju Stephen, **Chairman and Managing Director, Aadyah Aerospace** pointed to the wide-ranging applications of GPS—used by Google, Ola, Zomato, etc. These are all driven by precise location provided by a constellation of GPS satellites. In the US, satellites are linked to $5.7 trillion worth of economic activities each year.

India has rich space expertise and talent, he said. Given the fact that less than 20% of the 194 countries across the world have space design and launch capability, and soon they will aspire to enter the global space economy that is projected to be around $3 trillion by 2040 as per Goldman Sachs, there are huge opportunities for India in capacity building.

He had five suggestions, which have been derived from vision for Aadyah Aerospace:

- Reimagine space as an infrastructure asset which could then enable project development in PPP mode.
- Encourage space project developers; just as in the case of renewable energy sector there are players like Tata Power, Adani Green Energy who take the risk to develop, finance, build and operate and maintain renewable energy infrastructure. Similarly, space technology companies need developers to innovate, survive and grow. There is a need for a policy framework that supports developers.
- Promote space project financing and innovative financing models. One approach could be the build-and-operate model, like India, China and Japan are doing in the case of railways and roadways in some countries. Another way could be approaching development financing institutions like the International Finance Corporation and Asian Development Bank.
- Reimagine how government supports private space players. He cited the example of SpaceX to illustrate his point. Founded in 2002 SpaceX had raised only $32.1 million in August 2006. Same year, NASA made a grant of $278 million. By 2020, SpaceX had received US$8.7 billion from NASA and Department of Space. In February 2021, SpaceX was valued at $74 billion. Mr Stephen expressed hope that ISRO becomes the catalyst for government grants and contracts to flow to the private sector.
- Collaboration with global agencies (he gave the example of private Japanese companies working in global collaborations, including in NASA's lunar exploration programme).

Mr Nitish K Singh Co-founder & CEO, **Astrogate Labs** expressed optimism regarding market access to Indian companies in overseas market, and the chance to collaborate in space missions.

Ms Guler Kocak, **Founder & CEO, SPACELIS**, discussed the collaboration imperative in the environmental context. She said the first motivation towards collaborations in the case of her organisation is clean energy options, as the planet faces the risk of 1.5 degree rise in temperatures in a decade. Space technology should work towards zero carbon footprint goal, for example, by harnessing solar energy in space. The vision of all space technology players should be environmentalism and they should push Government towards that.

Ms Kocak discussed the problem of space debris too, and the need to work for recyclable components. There is great need for collaboration in these endeavours, by way of exchange of researchers and sharing of research outcomes, working jointly on regulations and sharing responsibility.

Mr James Palmer, Founder, Space Centre Australia discussed the possibilities of cooperation in education and learning, and research and development, and said one could collaborate even while being competitive.

Mr Arfan Chaudhry, International Director, UK Space Agency, highlighted three broad strands of space programmes: Science, security and trade and prosperity (return on investment). Science in space has always seen cooperation among countries. When it comes to security, space has civil and military dimensions. In the case of trade and prosperity, or return on investment, there is a lot of activity in the form of MoUs.

Increased commercialisation necessitates regulation, and dialogues at many levels: between space agencies, governments and commercial partners, but it also requires international dialogue to ensure that the regulation is consistent with participating nations. International forums are important in that respect.

Mr Artur Jutman, Managing Director, Testonica Lab, **Estonia** described his country's space journey, from zero presence about a decade ago, to a stage when, powered by government investments, there is a growing space presence. And companies in IT, software development and cyber security space, which would not have been expected to take the plunge into space sector, are successfully operating on global scale. His own company is planning participation in space missions and is joining European Space Agency's research programmes. For India, he had a few suggestions: concentrate on sectors that are not seen as space sectors (IT, software and electronics) and bring their

expertise into the space sector; and provide opportunities to universities local companies and who will find a way to the global space sector.

Mr C J Fong, National Space Organisation, Taiwan made a mention of his country's capabilities in space, including in early prediction of cyclones and their genesis, enabling legislation --the Taiwan Space Development Act announced in June 2021, -- and possibilities of collaboration with India and other countries.

Key Recommendations

- India should look to support countries that have not developed space capability, through training programmes, etc.
- Create a common platform for Indian products and services on the lines of the European Space Agency's ESA Start – that helps European suppliers to promote their capabilities, products and services.
- Reimagine space as an infrastructure asset which could then enable project development in PPP mode.
- Encourage space project developers; just as in the case of renewable energy sector there are players like Tata Power, Adani Green Energy who take the risk to develop, finance, build and operate and maintain renewable energy infrastructure.
- Promote space project financing and innovative financing models. One approach could be the build-and-operate model. Another way could be by approaching development financing institutions like the International Finance Corporation and Asian Development Bank.
- Increased commercialisation necessitates regulation, and dialogues at many levels: between space agencies, governments and commercial partners, but it also requires international dialogue to ensure that the regulation is consistent with participating nations. International forums are important in that respect.

Session 2: Highlight session: Human spaceflight and space exploration missions

Session Chair: Dr Unnikrishnan Nair S, Director, HSFC, ISRO

Panelists: Prof Radhakant Padhi, Aerospace Department, Indian Institute of Science (IISc)

Dr U K Singh, Director General, Life Support Systems, DRDO, Delhi

Mr Pavan G. Ranga, CMD, Rangsons Aerospace Pvt Ltd, Mysuru

Dr P Sreekumar, Former Director, SSPO, ISRO

Mr Ranganathan Sadashiva, CTO – Hybrid IT, HPE India

Mr V T Basker, Project Director, GSLV MkIII, VSSC, ISRO

Mr K G Vinod, Project Director, ECLSS, HSFC, ISRO

Key Assertions

Space exploration missions are pre-cursors to human spaceflights. In the realm of space exploration, ISRO has in recent years launched the Mars Orbitor Mission, Astrosat, Chandrayaan 1 & 2, and is undertaking Aditya L1 and SPOSAT missions. Citing these developments in his opening remarks, **Dr Unnikrishnan Nair S, Director, HSFC, ISRO** explained that the Mars Orbiter Mission, India's first inter-planetary mission, was directed at exploration of Mars surface features, morphology, minerology, and Martian atmosphere by indigenous scientific instruments. The Mission itself had to be accomplished in a tight timeframe of 10 months. ISRO thus became the 4th space agency to successfully send a spacecraft to Mars orbit.

The Astrosat had among its uses multi-wavelength astronomy. The Chandrayaan Mission was envisioned to have the Moon as an intermediate station for further space exploration. Chandrayaan 2 explored the presence of water on the lunarscape. Aditya L1 will be placed in the Halo orbit around Sun-Earth L1 point that is an ideal place to observe the universe without any disturbances. L1 is 1.5 million km away from the earth. XPOSAT will be the first dedicated satellite for polarization measurement in X-rays. Its launch date is scheduled in Q2 2022.

Dr Nair said that Gaganyaan Project, which will be India's first human space mission, is now the fifth vertical of ISRO. The mission is planned to have 3 crew on board for the duration of 3-6 days. For this, the human rated launch vehicle has been developed. The objective is to implement a sustained and affordable human and robotic programme to explore the solar system and beyond. The Gaganyaan Programme has as its components: 1) development of the Human Rated Launch Vehicle, 2) development of the Orbital Module, 3) End to End Mission, 4) Crew Life Support System.

Dr Nair said the programme includes new frontiers like development of half-humanoids. The programme will also open up new vistas for human spaceflights, and calls for new development in areas like regeneration and recycling of resources, space waste management, development of inter-connected large structures in space, space farming, manufacturing in space, bioastronautics. This will also call for ISRO to be coordinated with industry on different frontiers of the space economy, he stated.

Prof Radhakant Padhi, Aerospace Department, Indian Institute of Science (IISc) said developments in the space sector reinforce the stature of a nation. He also alluded to the major spinoffs from space research in diverse fields like bio-medical research, additive manufacturing, etc. He said the opening up of the space sector has spawned a range of collaborative opportunities that would be of the essence to private players.

Dr U K Singh, Director General, Life Support Systems, DRDO, Delhi said the human spaceflight missions are contributing to advancements in recycling, development of regenerative technology, waste management, among others. He also suggested that with robotics, it would be possible for developing farming on other terrestrial bodies. Safety measures are accorded the highest priority in the case of manned space flights, and

DRDO is engaged in the development of recovery vehicle, parachute system, simulation model for radiation, etc.

He said that greater advancement in propellor systems are key to taking the space missions to furthest frontiers of space. Participation of Indian industry in these areas are of vital importance, he said.

Referring to the opportunities in space tourism, he said that India could take a lead in developing human-centric training mechanisms through multiple centres.

Mr Pavan G. Ranga, CMD, Rangsons Aerospace Pvt Ltd, Mysuru highlighted some of the challenges that need to be addressed in order for industry to deepen its footprints in the space economy. Most private companies are engaged in build-to-spec or build-to-print activities, and extend design and manufacturing services. However, there is a need to promote product companies in this sector that are focused on R&D. Second, there is no structured platform where companies can interact with the academic or national space agencies. Third, most sub-systems are imported, and the suppliers are all too keen to dump them, whereas the importing companies would need access to larger sub-systems where those imported sub-systems can be tested and approved. Mr Ranga also called for Government to extend grants to space-related R&D initiatives.

Dr P Sreekumar, Former Director, SSPO, ISRO said that with industry engagement, it would be possible to reduce the gestation period between developments in the lab and the actual spaceflight. Responding to a question on role of industry in space science missions, he said that industry participation would not only help mobilise more financial resources, but also bring cutting-edge technologies to the fore. However, he said that the cost of missions would also go up. On a broader plane, he called for close collaboration between ISRO, industry and the academia.

Mr Ranganathan Sadashiva, CTO – Hybrid IT, HPE India said that digital transformation is taking place in the space sector too, and that companies like his are helping add strong computing capability to the missions and onboard the spacecraft. The computer power will help the space crew to take crucial decision, such as, on preventive health measures. While stating that AI-enabled robotics are at different maturity stages

for different industries, he said that a more comprehensive approach to AI is necessary for its application at scale. Smaller use cases of robotics in the space sector are coming into play, he said.

Mr V T Basker, Project Director, GSLV MkIII, VSSC, ISRO said the payload fraction for manned spaceflight is required to be low to ensure the overall crew safety. The Human Rated Launch Vehicle in its current state of development is only suitable for short stay in space, and cannot be used for more advanced missions like asteroid mining. He called for concerted efforts to augment launch vehicle capacity, development of high strength compositive motor cases, etc. He also informed that initiatives are underway to make the missions more cost-effective through efficient retrieval and reuse of different components of spacecraft. Also underway are initiatives to develop winged body for reentry and landing of spacecraft on land, or for the craft to land on legs.

Mr K G Vinod, Project Director, ECLSS, HSFC, ISRO said that space science and R&D have had a gamut of spinoffs for society like development of the heart pump, radial tyre, laser-based ophthalmic surgery, waste water recycling, air scrubbers for cleaning the environment, etc. Many of these innovations stem from the safety systems that are developed for the space missions.

Key Recommendations

- Greater advancement in propellor systems are key to taking the space missions to furthest frontiers of space. Participation of Indian industry in these areas are of vital importance.
- In space tourism, India could take a lead in developing human-centric training mechanisms through multiple centres.
- Most private companies are engaged in build-to-spec or build-to-print activities, and extend design and manufacturing services. However, there is a need to promote product companies in this sector that are focused on R&D.
- Build a structured platform where companies can interact with the academic or national space agencies.
- Provide importing companies access to larger sub-systems for testing imported sub-systems.
- Government may extend grants to space-related R&D initiatives.

- Concerted efforts required in India to augment launch vehicle capacity, development of high strength compositive motor cases, etc.

Session 3: Emerging Trends in SatCom: An India Specific Perspective: September 14, 2021

Session Chair:	Mr D Radhakrishnan, CMD, NSIL
Panelists:	Mr K Rathnakara, Director, SatCom-PO, ISRO HQ
	Ms Deepa Tyagi, Senior DDG Technical, Department of Telecom, Government of India
	Mr P J Nath, CEO, NELCO
	Dr Zaffar Sadiq Mohamed-Ghouse, Executive Director, Spatial Vision, Australia
	Mr Partho Banerjee, CEO & MD, Hughes Communications India Limited
	Mr Prashant Bhutani, Sr Sales Director, MEASAT
	Mr Harsh Verma, Sales Director, Asia for Fixed Data, SES Networks
	Mr V L Shankar, Senior Vice President, Reliance Jio projects

Key Assertions

This session brought together perspectives of policymakers, regulators, service providers and companies on taking big strides in the satcom sector.

Mr D Radhakrishnan, CMD, NSIL, in his opening remarks said that the global space economy is $370 billion strong and satcom services amount to nearly $110 billion and is significantly commercially lucrative business. But the satellite communication business requires huge capital investment, demonstration of capabilities and handling challenges of seeking regulatory clearances, licenses and authorisations, and establishment of a user base, besides ensuring development of capabilities to provide reliable and uninterrupted services to the end-user in this highly commercial and competitive market.

Highlighting the paradigm shift in the sector, he added that companies are looking at providing high throughput broadband connectivity through Leo Constellation approach and eventually the emerging Leo Constellations like One Web and Starling will have global footprints. Mr Radhakrishnan said there are ample opportunities emerging forIndian industry and towards developing and realising a major chunk of ground equipment required for meeting the connectivity needs. This, he said, is going to be a big boost to Indian manufacturing, as opportunities would arise from hundreds of satellites in Leo Constellations that need to be launched and replenished regularly, he added.

According to him, availability of launch vehicles in various categories starting from small satellite launcher to the heavy lift launches in larger volumes is going to be very important for the Indian space industry.

Ms Deepa Tyagi, Senior DDG Technical, Department of Telecom, in her address said that Telecom Engineering Centre (TEC), which is the technology arm of the Department of Telecom under the Ministry of Communications, Government of India, is responsible for formulation of national standards for all telecom and related ICT products, including satellite products.

She added that TEC has always been on the forefront of taking up development of standards for new technologies and equipment in telecom in the satellite domain and has published more than 60 standards for different satellite communication equipment and systems including modems, amplifiers, earth station antennas, etc. She said that TEC has also published standards for different satellite communication and networks such as V-SAT-based mobility services which include in-flight and maritime connectivity services, etc. She announced that TEC is also currently working on the formulation of new standards for NGSO satellite communication and consultation for it would start soon.

The recently published revised version of the standard for FSS and BSS satellite communication networks has added new frequency bands with revised antenna sizes for different types of networks. Parameters have been included to focus on interference free operation, while removing the limits on data rates for the different networks, keeping in mind the advancement in technology and increasing the throughput demands, she said.

Ms Tyagi said that satellite communication technologies are witnessing advancements and are competing in quality and efficiency offered by terrestrial services networks. She pointed out the trends that are expected to be seen in near future, including use of small satellites and low earth orbits, launch of reusable launch vehicles and new use cases for 5G and IoT.

She stressed that the perception that satellite technology is incapable of providing low latency connectivity is beginning to shift, as various companies are now in the planning and testing stages for deploying far greater numbers of satellites in this segment.

Mr K Rathnakara, Director, SatCom-PO, ISRO HQ said the impact of electronic communication has become part and parcel of daily lives as people embrace digital solutions for interactions and well as business transactions, which is ensuring convergence as well as synergy of terrestrial, cellular and satcom technologies. He added that a lot of new applications are coming up in India, which is a growing digital economy. As new consumers are getting added, the demand for bandwidth is increasing, and given the demographic profile of India, satellite communication is apt to provide connectivity to people living in inaccessible and hilly terrain.

Highlighting the emergence of new trends, especially during COVID-19 pandemic, Mr Rathnakara said that inflight connectivity, maritime connectivity, Internet of Things, online education, and 5G are some of the new applications that are coming out. How people watch TV is also undergoing transformation and moving towards user-centric video streaming service by OTT platforms, and satellite communication has the advantage of delivering content in multicast modes, he added.

According to him, new applications, specifically in the areas of automobiles, smart cities, smart homes, health care, energy sector, etc., would require low latency and highly reliable connectivity, and this is where satellite communication could play a key role owing to its inherent strength of high availability and reliability that can be offered through GEO, MEO and LEO-based satellite platforms.

In the area of space systems, he said new generation spacecraft are being built with technologies like multiple spot beams, steerable beams, flexible payloads, higher frequency bands, software defined radios, etc. The onboard resources are being optimised to meet the capacity requirement based on user needs, and flexibilities are being incorporated dynamically to meet the demand for a specific geographical region at a specified time, Mr Rathnakara added.

Mr P J Nath, CEO, NELCO, speaking from the perspective of a V-SAT service provider, said that the industry is excited to see new LEO satellites being planned for launch in the next few years. He added that this will open a huge market because of the low latency provided by LEO satellites as there will be a complementary technology in addition to terrestrial technology that will be offered.

With new technologies coming in and prices dropping consistently, industry will be required to protect consumers in the internet space, as well as offer inflight and maritime communication services, and that will be possible through geostationary satellites, particularly with software defined capabilities, he said.

The space industry is looking forward to a new space policy that would open up new segments and define important concepts in terms of daily operations, required parameters and address the boundary questions, etc., Mr Nath said, adding that with a combination of new technologies and the right kind of policy framework and regulations, satcom will be able to offer a wide range of services to end-users.

Dr Zaffar Sadiq Mohamed-Ghouse, Executive Director, Spatial Vision, Australia, focused his address on the application side of satcom. He said that in Australia, government's focus is on development of spatial digital twin infrastructure in each state which will bring together all applications.

He said that creation of digital twins using spatial data will bring in more efficiency and better planning for sectors as varied as horticulture and mining. He added that India and Australia could work together in this space as India is looking at privatisation of satcom sector while Australia is looking at private entities like startups to bring in more innovations in the sector. He also said that Australia has a programme called Smart Sat, which involves government, private sector, startups and also academia to bring in research and take that research collaboration back into the commercial ecosystem. On capacity building, he said that India could provide lessons to Australia in the area of telemedicine where remote surgeries are being conducted and senior doctors in cities are providing guidance to primary health centres in order to save life.

Mr Prashant Bhutani, Sr Sales Director, MEASAT said that the sheer scale of LEO Constellations that are coming up makes it believable that lower cost per bit is always going to be in their favour and Leo services in some way will take away the market from Geo service providers. But another way to look at it is the possibility of collaboration between Leo and Geo systems.

Highlighting the challenges for LEO systems, he said that there's no ignoring the fact that most of these systems will provide services over the entire world -- over both water and land -- and therefore 70% of their coverage area is going to be ocean. He added that developing satellite services in a single country with landing rights and local regulations is hard enough, but doing it across the globe for 195 countries, will pose different kinds of challenges. Also, it will be extremely cost intensive and challenging exercise to deal with issues arising due to laws related to international waters and airspace, he added.

Another issue he highlighted was the total cost of ownership when it comes to LEO constellations. He said that satellite operators are compelled to invest in capex every five to seven years, instead of every 15 to 20 years when compared to geostationary operators. The total cost of ownership for the ground segment needs to subsidise the user terminals, which at the moment is expensive. And they also need to factor in multiple gateways across the globe in order to make the service available everywhere, he added.

Mr Harsh Verma, Sales Director, Asia for Fixed Data, SES Networks said the satcom policy that was introduced in 2000 was a watershed moment for satellite communication in India which has seen rapid growth of V-SAT industry, and today it is the second largest V-SAT market in the world, just behind the US. Highlighting future opportunities, he said that in a vast country like India 300,000 V-SATs is just a tip of the iceberg. He said that today India has the highest data consumption in the world at 15GB data per month and is still growing. He also pointed out that connectivity will no longer be measured in terms of quality of service, but quality of experience of the end user.

Mr Verma said the new age satellite technologies, including the high throughput and very high throughput GEO satellites, Medium Earth Orbit satellites, and LEO satellites will all have a role to play in India. He added that big waves of growth will come from Digital Inclusion projects such as Bharatnet, and 5G, enterprise IT and IoT applications.

Mr V L Shankar, Senior Vice President, Reliance Jio projects said that Dr Pawan Goenka leading IN-SPACe will give a boost to the sector and help increase India's share in global space market. He added that going forward, satcom has to cater to the next generation applications like 4k/8k UHD in DTH space, TV-TV HD video calls, commercial and industrial IoT, etc.

Key Recommendations

- Companies are looking at providing high throughput broadband connectivity through Leo Constellation approach and eventually the emerging Leo Constellations like One Web and Starling will have global footprints. There are new opportunities for Indian industry in developing ground equipment required for meeting the connectivity needs.
- New applications, specifically in the areas of automobiles, smart cities, smart homes, health care, energy sector, etc., would require low latency and highly reliable connectivity; satcom could play a key role owing to its inherent strength of high availability and reliability that can be offered through GEO, MEO and LEO-based satellite platforms.
- With new technologies coming in and prices dropping consistently, industry will be required to protect consumers in the internet space, as well as offer inflight and maritime communication services, and that will be possible through geostationary satellites, particularly with software defined capabilities.
- Creation of digital twins using spatial data will bring in more efficiency and better planning for sectors as varied as horticulture and mining.